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January 31, 1988

Energy Research Abstracts

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ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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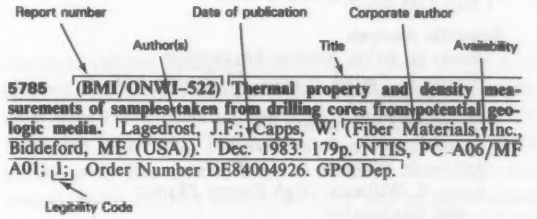
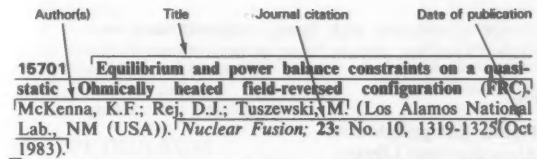
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 **(BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI–522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI–		
522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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Technical Information Service
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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

REFER ALSO TO CITATION(S) 2789

2787 **(DOE/PC/81210—T16) Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 8th quarterly (ending September 30, 1987).** Yang, D.C. (Michigan Technological Univ., Houghton (USA). Inst. of Materials Processing). 15 Oct 1987. Contract AC22-85PC81210. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000892/JAW.

Research continued during the quarter to study the two-stage flotation circuit in various configurations at the laboratory scale and to prepare for the pilot plant scale-up tests with large packed columns (2 ft square x 20 ft high). Several tasks of the project were carried out concurrently in an attempt to make up for the lost time due to the equipment failure that occurred earlier this year. All the research activities were designed to demonstrate the potential application of the static tube flotation technology for economic production of superclean coal (0.4-1.0% ash) from the domestic sources. The results to date show that this goal can be accomplished using one-stage or two-stage laboratory continuous flotation operations. The latter can be either an open or closed circuit system. Preliminary results from the economic analysis indicate a cost of $16 per ton of coal processed in a 100 ton per hour plant operating with a flowsheet similar to the one developed in the laboratory. At a recovery of 80%, the processing cost is near $20 per ton of superclean coal. Work on construction of two large packed columns is about 90% complete. The bulk coal samples (25 tons each of Pittsburgh and Lower Kittanning seam coals) were ordered and should arrive early next quarter. 2 figs., 2 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 2802, 2805, 2869, 3294, 3705

2788 **(DOE/PC/70786—T11) Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, March 1-May 31, 1987.** Eisch, J.J. (State Univ. of New York, Binghamton (USA)). 1 Jul 1987. Contract FG22-84PC70786. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002165/JAW.

The objective of this research is to uncover new catalytic processes for the liquefaction of coal and for upgrading coal-derived fuels. Basic to both the liquefaction of coal and the purification of coal liquids is the transfer of hydrogen from such sources as dihydrogen, metal hydrides or partially reduced aromatic hydrocarbons to the extensive aromatic rings in coal itself or to aromatic sulfides, amines and ethers. This study is exploring how hydrogen-transfer processes might be catalyzed by soluble, low-valent transition metal complexes under moderate conditions of temperature and pressure. The most important finding is that nickel(0) complexes and organoaluminum Lewis acids exert a marked cocatalytic action on hydrogen transfers between hydroaromatics and aromatic olefinic substrates.

2789 **(DOE/PC/79806—1) Characterization and suitability of superclean coals for hydroliquefaction feedstocks: First quarterly technical progress report, ending September 30, 1987.** Kim, N.K. (Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering). 15 Oct 1987. Contract FG22-87PC79806. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000932/JAW.

This report includes the results of research activities during the 1st quarter accomplished under grant FG22-87PC79806 entitled "Characterization and Suitability of Superclean Coals for Hydroliquefaction Feedstocks." The objective of the research is: to evaluate the effect of superclean coals as produced from various domestic coals by the MTU flotation technology on direct hydroliquefaction. The micronized and successively clean coals which range from 1.0% to as high as 20% in ash content and also contain various sulfur concentrations are to be assessed as coal conversion feedstocks. Thus, the proposed project is to evaluate the effects of ash, sulfur, and the ultrafineness of coal feed on the hydroliquefaction process.

2790 **(DOE/PC/80023—T10) Development of an in-situ hydrogen measuring instrument for coal liquefaction processes: Quarterly report, July-September 1987.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract AC22-85PC80023. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001344/JAW.

Over this past quarter's reporting period the Wilsonville operation was off stream until about August 15. The plant did not stabilize until September when the plant was contacted on the feasibility of inserting a vent line to facilitate operation. Some operational problems of the system at university occurred and were repaired. The permeation coefficient of liquid probe was measured and compared with previous work. The amount of hydrogen that exists in the Lummus coal liquid was measured using two different techniques. One technique is to heat the coal liquids from 515°K to 699°K (467°F to 800°F) and measure the permeation rate of hydrogen continuously not waiting until the temperature reaches a steady state. The purpose is to obtain some information on the temperature behavior when the coal liquid was heated. The other procedure is to heat the coal liquids to 500, 589, 644, 670, 700, and 730°K (440, 601, 700, 747, 800, and 855°F), respectively and measure the permeation rates at each temperature once the temperature is steady state. 5 figs., 4 tabs.

2791 **(DOE/PC/90529—4) Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 June 1987-15 September 1987.** Calo, J.M.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1987. Contract FG22-86PC90529. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001000/JAW.

In previous quarterly progress reports it has been indicated that a numerical model was being formulated to aid us in the interpretation/correlation of activated diffusion data in microporous coal chars. This quarterly technical progress report is devoted to describing progress on this front. The following has been accomplished during the reporting periods: A Monte Carlo model of diffusion processes in a porous material has been developed and debugged; This model has been validated for pure Knudsen diffusion in a one-dimensional, parallel, overlapping cylindrical pore network; The model has been extended to include the effects of wall adsorption as a prelude to the inclusion of surface diffusion; A linear least squares fit expression relating the diffusion parameter k_0/r to the porosity, was determined from numerical results of the

model; It was found that materials with the same porosity can exhibit diffusivities that differ by as much as 10% as a result of different pore size distributions produced by the effect of random pore overlap; The effect of molecular shape and size has been incorporated in the model to a limited extent. Some interesting preliminary results are reported as a result of this; and A proposal for computer time on the JVNC supercomputer at Princeton University to run the Monte Carlo model has been submitted.

2792 **(DOE/PC/90910—4) Enhanced coal liquefaction by low-severity catalytic reactions: Technical progress report for the period June to August 1987.** Davis, A.; Schobert, H.H.; Derbyshire, F.J. (Pennsylvania State Univ., University Park (USA)). Sep 1987. Contract FG22-86PC90910. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001663/JAW.

The objective of this investigation is to examine the potential and limitations of temperature-staged catalytic liquefaction. Experiments have been planned to examine the chemical reactions which occur during the low- and high-severity stages, the effects of coal rank and process conditions, the function of catalyst and influence of solvent donor capability. A bituminous coal and a lignite were subjected to temperature-staged liquefaction in the presence or model compound solvents and a recycle-solvent. Reactions were conducted in the absence and presence of a molybdenum catalyst using either hydrogen or nitrogen atmospheres. It was found that the catalyst, in general, promoted total conversion under hydrogen, but in the dihydrophenanthrene + catalyst + hydrogen system the catalyst significantly reduced the yield of oil. Evidence suggests that the catalyst interacts in a complicated way with both the reaction atmosphere and solvent. 11 refs., 8 figs., 4 tabs.

2793 **(GAO/RCED—87-90FS) Synthetic fuels: Status of the Great Plains coal gasification project.** (General Accounting Office, Washington, DC (USA)). 1987. 35p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Sponsors of the Great Plains coal gasification project in North Dakota defaulted on a federal loan in the amount of $1.54 billion. The Department of Energy has obtained title to the Great Plains project and is evaluating proposals from investment banking-type companies to assist it in selling the plant and its assets. This fact sheet highlights recent legal action concerning gas purchase agreements and mortgage foreclosure; the status of the project's sponsors' outstanding liability; DOE's progress in evaluating its options; revenue, expense, production, and plant employment data; capital improvement projects; and plant maintenance issues.

2794 **(ORF—840607) The operation of the CANMET flash hydropyrolysis unit for the period January to March 1984, inclusive.** Last, A.J.; Peczeli, C.F. (Ontario Research Foundation, Sheridan Park (Canada)). 7 Jun 1984. 42p. (MICROLOG—85-2077). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The first operating campaign of the CANMET Flash Hydropyrolysis unit was ten successful tests with Forestburg sub-bituminous coal at various temperatures, pressures, and coal particle residence times. Three runs were made with Prince Mine bituminous coal. No results were obtained. The tests took place between February 9 and March 30 and the Flash Hydropyrolysis unit, in general, worked very well. The analysis of the gas samples is available for all fifteen tests. The analysis of the char, on dry basis, is available for ten. 13 tabs.

2795 **(PNL-SA—15109) Sulfur in coal: Model studies of the role of ArS radicals in C-C and C-S bond formation and structural evolution in coal liquefaction.** Alnajjar, M.S.; Franz, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 5p. (CONF-871030—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001908/JAW.

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Experiments in this paper show the importance of thiyl radicals in sulfur containing coals during coal liquefaction processes. The presence of arylthiyl radicals enhances the cleavage of C-C, C=C, and C=C bonds in these otherwise refactory systems. Abstraction reactions, 1,2-phenyl migration from sulfur to carbon and displacement reactions at sulfur may be important mechanisms of structural evolution during liquefaction. In addition to cleavage of arylalkyl structures, the results also show that undesirable retrograde formation of inert diaryl- and triarylmethanes may be a consequence of the presence of sulfur and the attending aryl thiol structures. Thus, while a reaction medium including sulfur and hydrogen has been demonstrated to lead to the enhance cleavage of the bibenzyl model structure the present results suggest that retrograde reactions may be significant undesired pathways in coal liquefaction in the presence of sulfur. 17 refs.

2796 **(SU/CE—860505) Direct production of gasoline range hydrocarbons from syngas in a dual bed reactor system.** Bakhshi, N.N. (Saskatchewan Univ., Saskatoon (Canada). Dept. of Chemical Engineering). 5 May 1986. 161p. (MICROLOG—86-05106). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Conversion of synthesis gas (CO/H/sub 2/=1) to hydrocarbons was studied at atmospheric and elevated pressures using a 1/2 inch i.d. dual reactor system containing a Fischer-Tropsch (FT) catalyst followed by zeolite HZSM-5. Two FT catalysts were used. The base catalyst was 5% Ni/ZrO/sub 2/ and was prepared by the coprecipitation method. The FT catalysts were prepared in the laboratory and characterized by temperature programmed reduction, BET surface area, and atomic absorption. The ZSM-5 catalyst was also prepared in the laboratory and characterized by BET surface area, atomic absorption, x-ray diffraction, and constraint index determination techniques. The product distributions obtained using the two different FT catalysts combined with HZSM-5 were found to be different only slightly. However, the effects of the operating conditions on product distribution for the two FT catalysts were almost similar.

2797 **Fractional destraction of coal-derived residuum.** Warzinski, R.P. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp 229-241 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—).

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

An apparatus has been developed to fractionate coal-derived residuum by exploiting the solvent power of fluids near their critical points. Termed fractional Destraction, the method fractionates residuum according to the solubility of its constituent components in a supercritical fluid. The novel aspect of the approach is the incorporation of a system to promote reflux of less-soluble components onto a packed bed. Fractionation of residuum will facilitate the determination of previously unattainable information concerning the composition and process related behavior of this complex material. This paper describes operation of the unit to fractionate a residuum sample produced at the Wilsonville Advanced Coal Liquefaction Test Facility.

2798 **Effect of solvent density on coal liquefaction kinetics.** Deshpande, G.V.; Holder, G.D.; Shah, Y.T. (Dept. of Chemical and Petroleum Engineering, Univ. of Pittsburgh, Pittsburgh, PA 15261). pp 251-265 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—).

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Supercritical fluid extraction is an attractive process primarily because the density and solvent power of a fluid changes dramatically with pressure at temperatures near the critical. In complex supercritical extractions, such as the extraction of coal, the density of the supercritical fluid should also change the extractability of the coal. In this experiment a relatively inert supercritical fluid, toluene, was studied to determine the effect of density on the

coal extraction/reaction process. Extractions were carried out for two to 60 minutes at reduced densities between 0.5 and 2.0 and at temperatures between 647 and 698K. The data obtained can be explained by the hypothesis that coal dissolution is required preceding liquefaction reactions and that the degree of dissolution depends upon solvent density and temperature.

2799 **Isotope effects in supercritical water: Kinetic studies of coal liquefaction.** Ross, D.S.; Hum, G.P.; Miin, T.C.; Green, T.K.; Mansani, R. (Fuel Chemistry Program, SRI International, Menlo Park, CA 94025). pp 242-250 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—).

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Coal liquefaction studies with Illinois No. 6 coal in supercritical water/CO systems have demonstrated that a suitable model for liquefaction includes a branch point. In supercritical H/sub 2/O it was found that the toluene-soluble products (TS) profile leveled off at about 50%. However in supercritical D/sub 2/O, liquefaction was consistently superior to that in the protio medium, and the ultimate convertibility was about 60%. This inverse isotope effect can be explained by a model in which the limits to conversion are solely based on the competition between the kinetics of the parallel routes to TS and char, respectively. Conversion is thus limited by the kinetics of the conversion system, this limitation being even more severe in conventional donor systems which are inherently less effective for liquefaction than is water/CO. In principle the conversion of coal virtually completely to TS in a single step is feasible in a system with sufficient reducing potential.

0106 Properties

REFER ALSO TO CITATION(S) 2816, 3210

2800 **Swelling and plastic behavior of coal devolatilized at elevated pressures of air in the absence and presence of calcium oxide.** Khan, M.R.; Lee, C.W.; Jenkins, R.G. (USDOE Morgantown Energy Technology Center, WV). *Fuel Processing Technology;* 17: No. 1, 63-71(Aug 1987).

Swelling and plastic properties of an Lv bituminous coal (PSOC 1197) devolatilized at elevated air pressures (at 60 or 150 K/min) were onitored using a high-pressure microdilatometer. It was observed that the maximum swelling parameter (Vs) of the coal was markedly reduced when devolatilized at elevated air pressures, provided that the heating rate of the coal was sufficiently low (60 K/min to 923 K). In marked contrast, at a relatively higher heating rate (e.g. 150 K/min), the swelling of coal at elevated air pressures was closer to Vs obtained in N_2 pressures. An implication of this finding is that coal swelling can be very high at actual utilization conditions (rapid heating of coal in air). The reduction in coal Vs at a relatively slow heating rate is attributable, at least in part, to the preoxidation (chemisorption of oxygen to form oxygen crosslinks) of coal during initial heat-treatment in air (before there is significant devolatilization). Devolatilization of coal in the presence of CaO, however, markedly reduced the swelling of coal at various air pressures and heating rates. This reduction in coal swelling is attributed to crosslinking reactions of pyrolyzing coal that have been catalyzed by CaO. 15 refs., 4 figs., 1 tab.

2801 **Macromolecular structure of coals, 7. Mass spectrometry of pyridine extracts and depolymerized coal.** Lucht, L.M.; Hill, M.E.; Peppas, N.A. (Lawrence Livermore National Lab., CA (USA)). *Angewandte Makromolekulare Chemie;* No. 150, 123-126(May 1987).

Electron impact mass spectrometry and mass ion kinetic energy spectrometry were used to analyze: (i) the structure of uncrosslinked, predominantly aliphatic chains obtained by pyridine extraction of bituminous coals; and (ii) the identity of compounds found in depolymerized coal samples produced by the technique of Hooker et al. (1986). 15 refs.

2802 **Supercritical fluid extraction and chromatography of nonpolar nonvolatile coal-derived products.** Jordan, J.W.; Skelton, R.J.; Taylor, L.T. (Dept. of Chemistry, Virginia Polytechnic Institute and State Univ., Blacksburg, VA 24061). pp 189-201 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—).

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

In recent years supercritical fluid chromatography has gained attention as an alternative technique to high performance liquid chromatography for the separation of nonvolatile or thermally labile compounds, whose analysis with gas chromatography is impossible. The work presented here demonstrates a system that allows supercritical fluid extraction of a high boiling coal-derived material with subsequent direct introduction of a fraction of each extract onto a packed column for analysis via supercritical fluid chromatography. Detection of the eluates included variable wavelength UV and FTIR spectrometry. The coal derived products studied were taken from a bench scale coal liquefaction reactor, in which the same catalyst was used for twenty-five consecutive days. Chemical changes that occur as the catalyst decays were of prime interest. Most significant changes were noted in the aromatic fraction analysis, where a trend towards molecules with higher number of condensed rings was observed as the catalyst decayed.

0108 Waste Management

REFER ALSO TO CITATION(S) 3187, 3194, 3557

2803 **(DOE/PC/91021—T3) Flue gas cleanup technology utilizing energetic electrons: Technical progress report No. 4 for the period February 6, 1986-May 5, 1987.** Davis, R.W.; Finney, W.C. (ed.). (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1987. Contract AC22-86PC91021. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000169/JAW.

The technology for the removal of fly ash from flue gas utilizing energetic electrons advanced during this quarter. The work on the electron beam precharger consisted of equipment modification and ionization measurements in preparation for a new precharger design. Free electron charging work was an in depth analysis of previously obtained data and the design of equipment for new experiments. Substantial progress was made on both tasks. 9 figs., 1 tab.

2804 (IAEA-TECDOC—428, pp 253-263) **Present state of emission and removal of NO/sub x/ and SO/sub 2/ from combustion flue gases in Austria.** Getoff, N. (Vienna, Univ., Austria. Inst. fuer Theoretische Chemie und Strahlenchemie). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

Data concerning emission and removal of NO/sub x/, SO/sub 2/ and other pollutants from combustion flue gases in Austria are presented. According to the governmental measures the amount of the pollutants originating from the caloric power stations and industry should be strongly reduced, whereby chemical purification technologies are presently applied. The reduction of SO/sub 2/ and NO/sub x/ is prognosticated up to 1995. 6 refs, 3 figs, 5 tabs.

2805 **(PB—87-230223/XAB) Characterization, extraction, and reuse of coal-gasification solid wastes. Volume 2. Leaching behavior of fixed-bed gasification ash derived from northern great plains lignite. Final report, May 1983-June 1986.** McCarthy, G.J.; Hassett, D.J.; Henke, K.R.; Stevenson, R.J.; Groenewold, G.H. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Oct 1986. 104p. NTIS, PC A06/MF A01.

See also Volume 3, PB—87-215778.

The leaching behavior of eight specimens of fixed-bed lignite-gasification ash, including ash from the Great Plains (GPGA)

plant in Beulah, North Dakota, was studied. Four batch leaching tests were used: (1) EPA-EP; (2) a test with synthetic ND groundwater; (3) ASTM D3987-81; (4) long-term (120 day). One GPGA ash was leached according to the draft TCLP protocol. The EPA-EP test leachates from all of the ashes had metal concentrations a factor of ten or more below the values that define a hazardous waste according to the RCRA criteria. The ash specimens were highly alkaline and produced pH's in the range 10-13 during tests 2-4. Leachates from the EPA-EP test had RCRA metal concentrations comparable to, or less than, those derived from combustion ash derived from the same coal. The metal concentrations in leachates from tests 2 and 3 were also well below the RCRA limits. The long-term test used liquid-to-solid ratios of 2:1 and 20:1 and deionized water. During the 120 days, at least 5% of the Na, K, Al, S (as SO4), As, Mo, Se, B, and V in the ash was extracted.

2806 **Clean coal technology vs retrofits in acid rain precursor control.** Streets, D.G. (Argonne National Laboratory, IL (USA)). *Power Engineering;* 91: No. 9, 42-44, 47-48(Sep 1987).

The article discusses the development of clean coal technologies, with the view to ameliorating the acid rain problem. It is proposed that this approach has the potential to be more cost effective than the U.S.A. legislative proposals seeking to reduce emissions from existing facilities either through retrofit of major emission control equipment or through fuel switching. The article discusses the SO_2 and NO/sub x/ emission trends, an average plant lifetime, the Integrated Gasification Combined Coal cycle (IGCC) as a clean coal technology, legislative proposals to mandate emission reductions and future planning.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 2814, 2817

2807 **(GAO/RCED—86-155) Surface mining: Issues associated with Indian assumption of regulatory authority.** (General Accounting Office, Washington, DC (USA)). 1986. 26p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Several jurisdictional disputes are ongoing between the Office of Surface Mining Reclamation and Enforcement, Indian tribes, and state governments over who has the authority to regulate coal mining operations involving "Indian lands" outside the boundaries of the reservations. Disagreement over how to precisely define these lands and the significance of the state's historical regulatory presence on these lands is at the heart of the disputes. Attempts to resolve this issue through litigation have been unsuccessful.

2808 **(GAO/RCED—87-57) Surface mining: State management of abandoned mine land funds.** (General Accounting Office, Washington, DC (USA)). 1987. 42p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Surface Mining Control and Reclamation Act of 1977 promotes the reclamation of areas severely damaged in the past by coal mining operations. GAO reviewed the reclamation programs in Colorado, Kentucky, Pennsylvania, West Virginia, and Wyoming and found that they implemented financial control procedures and practices to ensure that the expenditures of reclamation funds are proper. Only one state, however, is complying with all related grant payment, audit, and inventory requirements. The states are generally reclaiming eligible, high priority projects as required under the act and are managing their reclamation projects in compliance with federal requirements.

0120 Mining

REFER ALSO TO CITATION(S) 2869, 3357, 3559, 3616

2809 **(GAO/RCED—87-34) Surface mining: Regulatory capability of Indian tribes should be assessed.** (General Accounting Office, Washington, DC (USA)). 1987. 10p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report addresses how successful cooperative agreements between the Office of Surface Mining Reclamation and Enforcement and the Indian tribes have been in advancing tribal regulatory proficiency concerning surface coal mining operations on Indian lands. GAO found that the Department of the Interior monitors the tribes' progress in completing tasks specifically required by the cooperative agreements. However, Interior has not comprehensively assessed whether the tribes' regulatory proficiency has progressed to the point where they could assume primary responsibility for regulating coal mining and reclamation activities on their land - the stated purpose of the agreements.

2810 **(HA—84) Development of a combined diesel exhaust cooler/scrubber for use in underground operations. Final report.** (Hovey and Associates Ltd., Ottawa, Ontario (Canada)). 1984. 41p. (MICROLOG—85-0268). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The purpose of this project was to design and build a prototype cooler/scrubber to determine the benefit of reducing water consumption by precooling exhaust gases when using a water bath type scrubber. The fabrication of the prototype cooler/scrubber is described including the modifications to provide access for test equipment and viewing of the 'scrubbing' action. The change in scope of the program necessitated by dynamometer scheduling is presented along with a list of test equipment purchased on the program. 2 figs., 3 tabs.

2811 **(NP—8750146) VG annual report 1986. Report of activities of Versuchsgrubengesellschaft mbH test mine Tremonia in Dortmund.** (Versuchsgrubengesellschaft m.b.H., Dortmund (Germany, F.R.). Versuchsgrube Tremonia). 1986. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750146/JAW.

The Versuchsgrubengesellschaft mbH carries out scientific investigations and practical experiments in order to prevent accidents and occupational diseases in mining. The staff in 1986 was 138, of which 48 were scientists, technicians, and others while 90 were workers (miners and craftsmen). Experiments and investigations in 1986 focussed on explosions, shotfiring, fires, hoisting, machinery, industrial safety, measurements and calculation, publications, documentation, national and international cooperation. Underground and surface facilities were improved and, if necessary, replaced. (HSCH).

2812 **(NP—8770001) Preventing earth contacts in medium-voltage networks in coal mining.** Gacka, M. (Dortmund Univ. (Germany, F.R.). Abt. Elektrotechnik). 1 Jul 1985. 98p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88770001/JAW.

A theoretical discussion is followed by a description of novel concepts, e.g. the concept of transverse differential protection and its application in different network conditions. Goals are: a) Selective protection against earth contact in parallel cables, independent of the network shape. b) There is no need for information transfer between the ends of the parallel line. This means a lower incidence of disturbances and higher economic efficiency. c) The method needs less expensive equipment than the present methods.

2813 **(PB—87-214078/XAB) Development of a powered helmet respirator suitable for use in coal mines. Technical memo.** Howie, R.M.; Coleman, G.C.; Graveling, R.A.; Graves, R.G.; Nicholl, A.G.M. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1987. 112p. (TM—87/03). NTIS, PC E07/MF E07.

A powered helmet respirator (PHR), the Racal Airstream AH6, has for several years been available to selected mineworkers in a number of United Kingdom collieries. The AH6 comprises a headshell and visor assembly offering head and eye protection, with a fan-filter system that directs filtered air into the wearer's breathing zone to provide respiratory protection with minimal breathing resistance being imposed on the wearer. After initial enthusiasm, its usage declined such that by 1982 less than 40% of the available AH6's were in regular use. As a result, the Institute of Occupation-

al Medicine (IOM) undertook to develop an improved PHR which would be more acceptable to mineworkers than the AH6. The report describes the progress made towards achieving this objective.

2814 **(PB—87-226049/XAB) Effect of longwall mining on surface subsidence of highways and bridges. Final report.** Hazen, G.A.; Sargand, S.M. (Ohio Univ., Athens (USA). Dept. of Civil Engineering). Nov 1985. 154p. NTIS, PC A08/MF A01.

Longwall mining is the most economical method for mining coal since it extracts a large percentage of the coal at a high extraction rate. Removing a high percentage of the coal results in surface subsidence with large horizontal strains. These effects are immediately noticeable and can cause damage to highways, bridges, and retaining walls. For this study subsidence profiles over three longwall panels mined beneath state highways in Southeastern Ohio were measured. The average maximum subsidence was 3.5 ft. The average maximum compressive strain recorded was 0.008 in./in. Three predictive methods for determination of displacements and strains were compared: (1) National Coal Board graphical method; (2) the profile method with empirical constants determined for Southeastern Ohio; and (3) a finite-element program. Excellent subsidence agreement was found with the profile method, and reasonable strain agreement was determined with the finite-element model.

0140 Combustion

2815 **(PB—87-220059/XAB) Pyrolysis and combustion of wood and peat as a single particle and a layer.** Aho, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1987. 122p. (VTT/RR—465). NTIS, PC E05/MF A01.

This report deals with laboratory-scale research methods and the results of the pyrolysis and combustion studies of peat and wood. The literature review at the beginning of the report is divided into three parts, the first dealing with the apparatus and working methods, the second with pyrolysis and combustion reactions in fuel, and the third with the emissions during pyrolysis and combustion. The experimental work at the Domestic Fuel Laboratory has been concentrated on the pyrolysis, combustion, and emissions of peat and wood studied as single particles and layers. Some experiments were made with powdered samples to probe the effect of temperature on the reactions.

2816 **(PSI—1024/Tr-730) Transformations of inorganic coal constituents in combustion systems: Quarterly report No. 4 for the period July-September 1987.** (PSI Technology Co., Andover, MA (USA)). 28 Oct 1987. Contract AC22-86PC90751. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001662/JAW.

This Fourth Quarterly Report is intended to serve as a Topical Report that summarizes the current status of the project and identifies work to be performed in Fiscal Year 1988. The objectives are as follows: (1) elucidation and quantification of the physical and chemical processes that occur in an environment typical of pulverized coal combustion, and which control the partitioning of coal mineral constituents among products (residual ash particles, aerosols, and vapors); (2) chemical and physical characterization of the coal, its intrinsic included, and extraneous mineral forms, and the spectrum of ash-related products in detail; and (3) development of a tractable, mechanistic model capable of predicting the observed features of the mineral matter transformation process. The principal of the program is that the transformation and partitioning of inorganic constituents into ash products is determined by two important factors. The first relates to the individual mineral forms, their size distribution and associations with each other and the carbonaceous char. The second is the time-temperature-chemical composition history of the coal and ash particles in the combustion system. Specific coals and specially prepared synthetic chars have been chosen to highlight the role of key minerals known to affect slagging and fouling in pulverized coal-fired combustion equipment. These include pyrites, illites, quartz, alkalies, and alkaline earths with varying size distributions and mineral/char associations. 24 refs., 17 figs., 6 tabs.

2817 **Development of coal-fired magnetohydrodynamics technology for mitigating acid deposition.** Huddleston, G.; Cornish, J. (MultiTech Div. of MSE Inc., P.O. Box 4078, Butte, MT 59702). pp 391-412 of Coal technology '86: Book II. Houston, TX; Coal Technology (1987). (CONF-861129—).

From Coal Technology '86: international coal utilization conference and exhibition; Pittsburgh, PA, USA (18 Nov 1986).

By the year 2010, coal-fired utilities are predicted to be the major man-made emission sources of both SO/sub 2/ and NO/sub x/, despite tighter emission limits probably legislated by that time. At its present state of development, open-cycle magnetohydrodynamics technology has the demonstrated capability to virtually eliminate SO/sub 2/ emissions and minimize the NO/sub x/ emissions arising from coal-fired combustion. Thus, the development of OCHMD presents an opportunity for mitigating the acid deposition problem currently associated with large-scale coal-fired electrical power generation. An evaluation of the relationships between commercialization of MHD technology and long-term acid deposition abatement policies and regulatory controls is presented. Key environmental and engineering design issues which affect the future viability of MHD power generation are compared with corresponding costs for conventional steam-electric coal-fired power generation as well as atmospheric fluidized bed combustion, pressurized fluidized bed combustion, and combined cycle coal gasification.

2818 **Numerical model of coal/hydrocarbons droplets in spray combustion.** Chung, J.N. (Washington State Univ., Pullman). pp 1-7 of AIAA 22nd aerospace sciences meeting. New York, NY; American Institute of Aeronautics and Astronautics (1984). Contract FG22-80PC30216.

A numerical model is formulated for the fluid flow, heat and mass transfer, and combustion processes of a coal/hydrocarbons slurry droplet in spray combustion. For relatively high Reynolds number flows, the evaporation and out-gasing of volatile fuels are modeled through a boundary layer approach. Flame sheet approximation is adapted for the combustion of volatile fuel. In the coal agglomerates, a simplified porous media transport model is applied. A fast kinetics model and a kinetics-mass diffusion model are employed for the combustion of coal agglomerates. Comparisons with experiments are also shown. 20 references, 3 figures.

0160 Health And Safety

REFER ALSO TO CITATION(S) 2813, 4564

2819 **(PB—87-222162/XAB) Impact of coal dust in gastric cancer and defense mechanisms. Final report.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 16p. NTIS, PC A02/MF A01.

In efforts to further define the role of exposure to coal dust in subsequent development of gastric cancer, several studies were performed and were highlighted in this report. Studies on the mutagenicity of different ranks of coal dust were conducted using the Ames Salmonella mutagenicity assay system. High mutagenic activity was found when extracts of bituminous, sub bituminous, and lignite coal dust were reacted with nitrite, a chemical found in the stomach, under acidic conditions. Studies on the effect of coal dust and its extracts on the interferon system indicated that nitrosated coal dust extracts at acidic conditions contain substances which are highly mutagenic and inhibitory for interferon induction. Virus infection studies were performed with the cytochrome-P-450 enzyme in efforts to understand the relationship between xenobiotic metabolism and antiviral activity in mice exposed to coal dust.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 2807, 2809

02 PETROLEUM

REFER ALSO TO CITATION(S) 4010

0201 Reserves

2820 **(ONR—5957-1) Oil and gas exploration, drilling, and production summary, 1983.** Trevail, R.A.; Parkvis, P.J.; Parker, D.K. (Ontario Ministry of Natural Resources, Toronto (Canada)). 1987. 324p. (MICROLOG—87-03907). Ontario Ministry of Natural Resources, Public Information Centre, Whitney Block, Room 640, Queen's Park, Toronto, Ont., Canada M7A 1W3; $20.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents statistical data for a 1983 summary of petroleum and natural gas activity. The year's highlights, geophysical and geochemical activity, leasing statistics, production figures, and drilling activity are categorized. Cumulative statistics are presented as well. 31 figs., 25 tabs.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 2820

2821 **Downhole tool sniffs out fractures.** *Drilling-DCW;* 48: No. 3, 29(May 1987).

This article reports that a new tool has been designed and successfully tested that can designate which direction from a borehole a particular fracture is located. Albuquerque-based Sandia National Laboratories tested the new tool. The prototype was built by Southwest Research Institute of San Antonio. During field tests, the tool detected simulated fractures more than 30 ft away from a test borehole. It determines fracture direction by transmitting highly directional and powerful radar pulses in a known direction. The pulses last eight billionths of a second and their frequency spectrum range up to the VHF (very high frequency) band. Discontinuities in the rock interrupt and reflect radar signals so that a signal's return to the tool indicates the presence of fractures. The return signal's time delay translates into distance from the borehole. The transmitter and receiver rotate in place, permitting the tool to scan for fractures in all directions.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 2820, 2869

2822 **(DOE/BC/10842—5) Flow in porous media, phase behavior and ultralow interfacial tensions: Mechanisms of enhanced petroleum recovery: First annual report, October 1, 1985-September 30, 1986.** Davis, H.T.; Scriven, L.E. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). Oct 1987. Contract AC19-85BC10842. 240p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE87001260/JAW.

A major program of university research, longer-ranged and more fundamental in approach than industrial research, into basic mechanisms of enhancing petroleum recovery and into underlying physics, chemistry, geology, applied mathematics, computation, and engineering science has been built at Minnesota. The 1985-86 outputs of the interdisciplinary team of investigators were again ideas, instruments, techniques, data, understanding and skilled people: 28 scientific and engineering publications in leading journals, two Ph.D. theses, the author of one going to industry, the other to a university, numerous presentations to scientific and technical meetings, and to industrial, governmental and university laboratories in the US., Europe and South America; and vigorous program of research visits to and from Minnesota. This report summarizes the papers and theses that emerged during the period 1 Oct 1985 to 30 Sept 1986 and features fifteen major accomplishments of the program during that year. Abstracts of the 28 publications and 2 theses are reported and several major accomplishments are reported in greater detail. Further details of information transfer and personnel exchange with industrial, governmental and university laboratories appear in Quarterly Reports available from the Department of Energy and are not reproduced here. The six sections in this report have been processed separately for inclusion in the Energy Data Base.

2823 **(ERCB/C—870612) Chevron Canada Resources Limited. Amendment to Board approval No. 5147. Enhanced recovery. Mitsue Gilwood A Pool.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 12 Jun 1987. 5p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

Chevron Canada Resources Limited applied to permit conversion of the 4-27 well to fresh water injection service for the purposes of repressuring the miscible flood pattern, miscible fluid confinement, and pressure support for waterflood producers. Gascan Resources Ltd., operator of an adjoining waterflood project, filed an intervention stating that water injection would result in loss of recoverable and premature flooding of a Gascan well. Because of time restraints, the Board indicated the well would be initially subject to Gascan conditions but noted the need for a permanent set of conditions and procedure. The issues to be resolved became the need for injection controls and a procedure for expeditious consideration of requests to vary any conditions. The Board approved the conversion of the well; conditions proposed by Gascan to be issued in the future. The views of Chevron, Gascan, and the Board are presented.

2824 **(GAO/RCED—86-224) Offshore oil and gas: Final annual report on shut-in and flaring wells.** (General Accounting Office, Washington, DC (USA)). 1986. 6p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO believes that the Department of the Interior's methodology for allowing Outer Continental Shelf Oil and gas wells to be shut in or to flare natural gas is reasonable. GAO also believes the elimination of Interior's reporting requirement will not diminish its responsibility for administering mineral exploration and development and conserving the natural resources of the OCS.

2825 **(GULF/C—8507) The use of alkaline waterflooding as an enhanced recovery process for heavy oils.** Azzam, M.I.S.; McCorriston, L.L. (Gulf Oil Canada Ltd., Sheridan Park, Ontario. Research and Development Dept.). Jul 1985. 181p. (MICROLOG—86-04146). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A laboratory study of alkaline waterflooding of two Saskatchewan heavy oils has been conducted. The objectives of the study were to assess the potential of the process for enhancing the recovery of these, and similar, heavy oils, and to investigate the controlling process mechanisms. Interactions of various candidate alkaline injection fluids with oil, formation water, and reservoir core material have been examined under idealized laboratory conditions. The emphasis has been on assessing the relative effects of the alkaline additives, sodium hydroxide and sodium orthosilicate at various concentrations, in comparison with plain brine-flooding. The work included characterization of the oils and injection fluids, qualitative assessment of the injection fluids-formation water interactions, wettability investigation using the sessile drop method, interfacial tension study employing the spinning drop technique, comparative synthetic and preserved core displacement experiments, emulsion examination, and alkali consumption estimation. The most important finding of the study is that the oil recovery improvement due to alkaline injection into the synthetic core system approaches that of steam in similar cores and laboratory set-ups. This finding suggests a good potential for the process with the examined, and similar, heavy oils. The rock reactivity study, however, indicates the potential for strong interactions between the alkalies and reservoir material. This suggests that further detailed chemical laboratory studies of these interactions are needed before the feasibility of

pilot testing such a process can be fully defined. Because of the complexity of the various fluid-rock interactions, the process appears to be very strongly site-dependent. 41 figs., 34 tabs.

2826 **(GULF/C—8601) Influence of the reservoir matrix on the mechanism and kinetics of the in situ combustion process for heavy oil recovery. Volume 1 of 2.** Lynch, T.R.; Thompson, J.; Cavaliere, G. (Gulf Oil Canada Ltd., Sheridan Park, Ontario. Research and Development Dept.). Jan 1986. 48p. (MICROLOG—86-04145). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Volume 1 presents all the experimental work, discussion, and conclusions, and key tables and figures. Volume 2 is primarily a set of appendices in which, for completeness, the TGA raw data is reported. The overall objective of this proposal is to obtain a better definition of the mechanism of heavy oil recovery by the in situ combustion process, through improved measurement of fuel laydown kinetics. The specific objectives are to determine if the remarkably low activation energies for coke formation that are employed in numerical simulations of firefloods are due to clay catalysis, and to evaluate the significance of coke devolatilization on fuel availability. Experimentally, the effect of clay on coke formation in in situ combustion has been studied by the use of isothermal reactors operated at pressures and temperatures corresponding to those in a reservoir in the region of the firefront, with either Pelican or Delmas crude oils, and by non-isothermal thermogravimetric analysis of smaller samples at atmospheric pressure employing Pelican vacuum resid in place of total crude. The amount of coke formed has been measured by sample combustion and measurement of carbon dioxide formed and by mass loss on combustion. 28 figs., 34 tabs.

2827 (NEI-FI—1, pp 9.8.1-9.8.12) **Use of computer tools for safety and reliability analysis.** Haugen, S.; Vinnem, J.E. (SikteC A/S, Trondheim, Norway). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Safety and reliability analysis very often consists of much simple but tedious calculation work. Changes or updating of some figures will normally be required at some stage, requiring extensive recalculations. There is also the possibility that errors can be made. Finally there is very often a need for performing sensitivity studies because of large uncertainties in underlying figures. All this has made us turn towards computerization as a means to perform parts of safety and reliability analyses. SikteC has developed and used computer applications for a wide range of problems. This includes general programs that have been used in several similar analyses. Among these are COCOS (Coarse Concept Safety analysis) and ASTRA (Assessment of Transport regularity). Both have shown their ability to analyse problems efficiently and are particularly useful in identifying problem areas and evaluating measures to reduce the negative effects. In addition to this SikteC has also developed dedicated tools for solving particular problems. For this purpose we have used 4 generation tools. The reduction in development time when using such tools compared to traditional programming, makes it interesting even for minor studies. The paper will describe our experiences with use of computer tools and give examples of how computer tools have been used to improve speed and efficiency in safety and availability analysis.

2828 **(NP—8750142) Brine-stable polymers for enhanced oil recovery.** Boessler, H.H. (Roehm G.m.b.H., Darmstadt (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1986. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750142/JAW.

New water soluble acrylic polymers should be developed for use as mobility control agents in enhanced oil recovery. Different types of acrylic polymers in aqueous solution, as solid products, and as emulsion in mineral oil have been polymerized. Polymethacrylamide, copolymers with cationic and anionic monomers (polyampholytes) and copolymers of (meth)acrylamide with carboxylic, phosphonic and sulfonic acids monomers have been tested. At a shear rate between 10 and 50 s/sup -1/, which should be representative for polymer flooding, nearly all polymers had a viscosity below 10 mPa.s, when dissolved in high-salinity brine. Only copolymers with acrylamide and sulfonic-acid-monomers had a viscosity of about 10 mPa.s and showed additional oil recovery in laboratory core-flood tests. With 20 figs.

2829 **(PB—87-217733/XAB) US oil production: the effect of low oil prices. Congressional summary report.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1987. 29p. (OTA-E—349). NTIS, PC A03/MF A01.

This special report presents the results of Office of Technology Assessment analyses of a group of factors they feel will strongly influence the future direction of U.S. oil production. These factors include the expected profitability of new investments in drilling, the potential of new oil exploration, development, and production technologies, the nature of the remaining oil resource base, and structural changes in the oil industry. This report also provides a brief discussion of some policy options for Congress to consider if it decides to moderate the expected accelerated decline in U.S. oil production.

2830 **(PRI—87/1) Gas flooding references.** Sayegh, S.G. (comp.). (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Jan 1987. 77p. Petroleum Recovery Institute, 3512 - 33rd. St., N.W., Calgary, Alta., Canada T2L 2A6; $10.00 CAN.

This list of references was compiled on miscible gas flooding. The references are alphabetical by author and key words have been added to many of the entries. To enhance the utility of this compilation, it has been put on floppy disk available from the Petroleum Recovery Institute.

2831 **(PRI—87/2) Rock-carbonated brine interactions in Cardium formation and Beaverhill Lake group core floods.** Sayegh, S.G.; Krause, F.F.; Girard, M.; DeBree, C. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Mar 1987. vp. Petroleum Recovery Institute, 3512 - 33rd. St., N.W., Calgary, Alta., Canada T2L 2A6; $25.00 CAN.

When CO/sub 2/ is injected into petroleum reservoirs it partitions between the oil, brine, and gas phases, forming carbonic acid in the brine phase. The brine's pH is lowered and it will contain carbonate and bicarbonate ions as well as undissociated CO/sub 2/. This report details the effect of this mechanism on the properties of two Alberta reservoir rocks and consequently on the enhanced oil recovery procedure. Flow tests were performed in a titanium core flooding apparatus. CO/sub 2/-saturated brines were circulated continuously through the core. All of the core floods were conducted at 45/sup 0/C using 5 wt% NaCl brines saturated with CO/sub 2/ at 13.8 MPa, and were carried out in oil-free cores. Permeabilities were monitored during the floods and brine samples were periodically taken for ion analysis. After the floods were completed, the cores were sectioned for microscopic examination.

2832 **(ZE—850422) Technical and economic assessment of the application of membrane technology for treating oil/water/mineral emulsions. Three Volumes. Final report.** (Zenon Environmental, Inc., Burlington, Ontario (Canada)). 22 Apr 1985. 390p. (MICROLOG—85-4583). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The prime objective was to assess the technical and economic viability of applying membrane technology to the treatment of produced water emulsions. A review of literature and present technology suggested that there is considerable potential for membrane application to produced water treatment. Ultrafiltration membranes have been used successfully in other industries for emulsified oil recovery and reversed osmosis systems have successfully applied to the treatment of boiler feedwater. Volume I contains a review of literature and industrial processes related to the topic. The results of experimental work are contained in Volume II. Appendices are presented in Volume III. Initial laboratory work involved a complete characterization of a sample of produced water emulsion. The

concentration of oil in a very stable emulsion was 1700 mg/l. Prescreening tests were conducted on twenty membranes manufactured from six different materials. One membrane of each type of material was chosen for further work based on the results of prescreening tests. Membrane screening tests with the six best membranes were conducted. All membranes consistently removed virtually all oil from the feed. The results also demonstrated that effective cleaning procedures will be critical to the economic viability of the application. Reverse osmosis tests demonstrated that RO membranes can in one simple step produce boiler feed water quality water from produced water which has had oil removed. Economic assessments were conducted. 47 figs., 37 tabs.

2833 **Capillary pressures and gas relative permeabilities of low-permeability sandstone.** Ward, J.S.; Morrow, N.R. (New Mexico Petroleum Recovery Research Center). *Journal of Petroleum Technology;* 2: No. 3, 345-356(Sep 1987).

Use of a high-speed centrifuge for capillary pressure measurements on low-permeability sandstones has been investigated. Curvatures for air/brine and air/decane displacements are compared. Capillary pressures of up to about 800 psi [5516 kPa] for gas displacing brine were extended over an order of magnitude by measurement of isotherms for desorption of water. Capillary pressures measured by high-speed centrifuge merged satisfactorily with results derived from the desorption isotherms. No distinct irreducible water saturation was observed. Permeabilities to gas at various levels of water saturation were also measured and found to be generally consistent with previous relative-permeability measurements.

2834 **Two- and three-phase relative permeabilities of micellar fluids.** Delshad, M.; Delshad, M.; Pope, G.; Lake, L. (Petroleum Engineering Dept., Univ. of Texas, TX). *SPE (Society of Petroleum Engineers) Formation Evaluation;* 2: No. 3, 327-337(Sep 1987).

Two- and three-phase relative permeabilities have been measured for a low-interfacial-tension (IFT) brine/oil/surfactant/alcohol mixture in Berea sandstone cores. The measurements were done at steady-state conditions with a constant nominal capillary number of 10/sup -2/. These are the first three-phase micellar relative permeabilities reported to date. Continuous and slug displacements of both partitioning and nonpartitioning radioactive tracers were run for each steady-state experiment. The effluent tracer data from these experiments were analyzed by a capacitance model. Both excess phases flowing with the microemulsion showed significant capacitance effects, but the microemulsion did not. The absence of capacitance indicates that the microemulsion was probably the wetting phase in these low-IFT flows, even more wetting than the excess brine phase. The relative permeability of each phase is a function of only its own saturation during three-phase flow. Polymer dissolved in brine had little effect on the relative permeabilities of brine and microemulsion in two-phase flow.

2835 **An experimental investigation of gas-bubble breakup in constricted square capillaries.** Gauglitz, P.A.; St. Laurent, C.M.; Radke, C.J. (Chevron Oil Field Research Co., La Habra, CA). *Journal of Petroleum Technology;* 39: No. 9, 1137-1146(Sep 1987).

Recent advances in EOR involve generating foam within underground porous media to displace the oil. The authors investigate the important snap-off mechanism of gas-bubble generation in constricted square capillaries experimentally. The snap-off of smaller bubbles from a larger bubble as it moves through the constriction is recorded on 16-mm movies. The time required for bubbles to snap off once they move past the constriction and the length of the generated bubbles are obtained from viewing the movie frames. The bubble capillary number, μupsilon/sub T//σ, is varied from 10/sup -5/ to 5 x 10/sup -3/ by adjusting the wetting-fluid viscosity, μ, and the surface tension, σ, by adding aqueous surfactants to mixtures of glycerol and water, and by altering the bubble velocity, upsilon/sub T/. Results show that a dimensionless time to snap-off depends weakly on the capillary number and that the generated bubble size increases almost linearly with increasing capillary number. Surfactants create dynamically immobile interfaces for surfactant solutions of 1 wt% sodium dodecyl benzene sulfonate (SDBS) and Chevron Chaser SD1000. Compared with the surfactant-free solutions, the time to breakup with surfactants increases by a factor of about 3; generated bubble length increases by a factor of at most 3.

2836 **Partitioning of nonionic and anionic surfactant mixtures between oil/microemulsion/water phases.** Graciaa, A.; Lachaise, J.; Bourrel, M.; Osborne-Lee, I.; Schechter, R.S.; Wade, W.H. (Univ. of Pau). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 3, 305-314(Aug 1987).

Mixtures of different surfactant types have been proposed for application in polymer/micellar flooding processes. In some cases, severe fractionation of such mixtures is found even in short core experiments. In this paper, a new theory of surfactant partitioning between phases is developed and tested. Polydisperse nonionic surfactants blended with an anionic surfactant are considered. Important parameters in the theory are the critical micelle concentrations (CMC's) of surfactant mixtures in water and the partition coefficients of the surfactant between oil and water measured at total surfactant concentrations less than the CMC. From these simple experiments, surfactant fractionation in microemulsion systems can be modeled. The authors show that the fractionation of polydisperse ethoxylated nonionic surfactants between excess oil and water phases is not as severe in the presence of anionic surfactants as it is in systems containing only nonionic surfactants.

0204 Processing

REFER ALSO TO CITATION(S) 2853, 2918, 2919, 2923

2837 **(CEG—8611) A study into the separation of nitrogenous material from naptha fractions. Final report.** (Cambrian Engineering Group Ltd., Mississauga, Ontario (Canada)). Nov 1986. 49p. (MICROLOG—87-03889). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum:T5; MF $10 CAN.

Results showed it is possible to remove the nitrogenous compounds from vaporized model solution using a combination of zeolite 13X, carbon RZN-1 and montmorillonite clay as adsorbents. However, this combination adsorbent column did not work when commercial naphtha fractions were tested. The properties of the naphtha fractions were much more complex than the model solution. Desorption study using displacement solvent was investigated. Toluene and isopropanol in vapour and in liquid states were tested. The results revealed that it is not feasible or economical to desorb the adsorbed nitrogenous compounds from the adsorbents; large volumes of displacement solvent were required. A two-volume appendix of experimental results is included.

2838 **(GULF/C—85) Diesel and middle distillate quality and yield improvements. Final report.** Notzl, H.; Simmons, R.A.; Souhrada, F.; Stollard, J.W.; Tharby, R.D. (Gulf Oil Canada Ltd., Sheridan Park, Ontario. Research and Development Dept.). [1985]. 119p. (MICROLOG—86-02905). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A secure supply of quality middle distillate for Canadian use in the long term is contingent upon the petroleum refining industry's ability to efficiently balance oil resources against product requirements. The middle distillate pool faces reductions in quality as more heavy and synthetic oils are processed. The use of middle distillate for the manufacturing of fuels is influenced by the seasonal constraints imposed by cloud point. The Canadian climate has wide variations in ambient temperature year round and the supply of distillate fuels to the Canadian market requires elaborate blending strategy. The formation of wax in a distillate fuel is undesirable and has to be avoided in the formulation stage. The cloud point or wax appearance temperature is used as the control parameter for the various marketing seasons. The three basic fuel types considered were Winter (-40/sup 0/C cloud pt.), Spring/Fall (-18/sup 0/C cloud), and Summer (0/sup 0/C cloud), which cover all the marketing seasons. The purpose of this work was to evaluate middle distillate pool size and quality and to demonstrate improvement of ignition quality by the use of additives and upgrading. Also investi-

gated was the reprocessing of heavy catalytically cracked gasoline for producing another diesel fuel blending component and thus extending the middle distillate pool. 27 figs., 24 tabs.

2839 **(GULF/C—8502) Impact of problematic components of synthetic crude processing.** Chmielowiec, J. (Gulf Oil Canada Ltd., Sheridan Park, Ontario. Research and Development Dept.). Feb 1985. 76p. (MICROLOG—86-03513). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The utilization of synthetic crude oils, when they become widely available, will be in the production of liquid transportation fuels. In conventional petroleum refining, a significant portion of these fuels are produced by converting residual oils into naphthas and middle distillates using catalytic processes. Since syncrude and other alternate feeds usually contain higher concentrations of metals, nitrogen, oxygen, and sulfur, the economic feasibility of the catalytic processing is markedly affected by their presence. For instance, hydrocracking requires more severe hydrogen pretreatment due to the sensitivity of the hydrocracking catalyst to increased concentrations of nitrogen and sulfur compounds. In addition, metals such as vanadium, nickel, and iron have deteriorating effects on catalyst life and promote undesirable side reactions. Several pretreatment types are potentially available for improving economics of processing in fluid catalytic cracking or hydroprocesses. These pretreatments are anticipated to improve quality of catalytic cracker feed and maximize its output, while limiting coke laydown and metals buildup during secondary catalytic upgrading. The pretreatments involve a rejection of polar/carbon-high components and recovery of lighter, more processable material. Among many known processes, primary upgrading processes such as delayed coking and supercritical fluid extractions have been commercialized. The primary objective of this project was to obtain background information on the nature of problematic components and their roles in processing heavy and synthetic feedstocks. A secondary objective was to define a possible new pretreatment process appropriate for facilitating upgrading residual oils.

2840 **(SNC/TD—8303) Proposal for authoritative review and critical assessment of commercial and emerging technologies for the separation of stable oil/water/mineral emulsions with emphasis on bitumen and heavy oil application.** (SNC Group, Montreal, Quebec (Canada). Technical Development Dept.). Mar 1983. 219p. (MICROLOG—85-3428). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The aim of this study was to select the most effective methods for separating oil/water/minerals, stable emulsions which occur in the secondary recovery of petroleum or tar sand bitumin. Information was gathered by literature survey and contacts with developers, users and individuals to determine: types of emulsions and their characteristics, i.e. the chemical compositions, the sources and the stability, background information on what methods have been used to break these emulsions and what the degree of success there has been. All the information was critically reviewed to evaluate all methods. A set of criteria will be developed to judge and select the best methods. The criteria included all factors affecting performance, degree of separation, ease of operation and service life under field conditions.

0205 Products And By-products

2841 **(AD-A—183784/8/XAB) Cost-savings possible with Air Force conversion to JP-8 as its primary fuel. Summary report, January-April 1987.** Martel, C.R. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). May 1987. 29p. (AFWAL-TR—87-2037). NTIS, PC A03/MF A01.

JP-4 has been the primary fuel for the USAF since 1951. However, in 1979 the USAF converted to JP-8 as its primary jet fuel for its operations in Great Britain. Recently, the North Atlantic Treaty Organization (NATO) began the switch from JP-4 (F40) to JP-8 (F34) as its primary jet fuel. However, JP-4 continues to be the primary USAF jet fuel within the continental United States. The cost and manpower savings possible by converting from JP-4 to JP-8, as the primary jet fuel for the Air Force, are identified and estimated. The much lower volatility of JP-8, as compared to JP-4, accounts for the anticipated savings. For example, aircraft fuel systems must be purged prior to maintenance, and purging aircraft fuel systems that have contained JP-4 can take hours to days. With JP-8 purging may not even be necessary under most ambient temperatures. Another major savings is the reduced evaporation of JP-8, as compared to the more volatile JP-4. Finally, reduced fatalities and casualty losses resulting from ground and flight accidents are estimated.

2842 **(HA—8605) Literature review on pitch utilization and technical proposal for a catalytic pitch conversion system.** (Hatch Associates Ltd., Toronto, Ontario (Canada)). May 1986. 226p. (MICROLOG—87-04037). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A literature review of processes for the consumption or conversion of petroleum pitch (525/sup 0/C+) has been completed as Task 1 of this study. A wide range of sources from conventional crude oils through heavy oils and bitumen processing to coal liquefaction were considered for the pitch. Five major types of pitch conversion process were reviewed: non-catalytic and catalytic pyrolysis, hydrogen addition, non-catalytic and catalytic gasification. A review of the basic research and proposed reaction mechanisms was done for each major type of process prior to summarizing the specific processes. For each specific process a flow schematic, process description, product yields and properties have been developed. Comparative economic data could not be developed from the literature review since each case is on a different economic basis. Where available, the utility consumptions and a capital cost value were provided.

0206 Health And Safety

REFER ALSO TO CITATION(S) 2905, 2906

2843 (NEI-FI—1, pp 10.2.1-10.2.8) **Application of systematic risk analysis in connection with the implementation of the EEC risk directive 82/501/ECC in Denmark.** Hagen, H.; Petersen, K.E. (Directorate of National Labour Inspection, Copenhagen, Denmark; Risoe National Lab., Roskilde, Denmark). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

The EEC Council Directive on the major hazards of certain industrial activities was adopted June 14, 1986. The Directive is now being implemented through provisions issued by the Ministry of Labour and the Ministry of the Environment. To fulfil the provisions some of the manufacturers have to present a safety case to the authorities. Manufacturers having facilities with large amounts of dangerous materials or complicated or less well-known processes may have to include a systematic risk analysis as a part of the safety case. The experience accummulated with regard to the use of systematic risk analysis in Denmark prior to and in relation to the Directive is reviewed.

2844 (NEI-FI—1, pp 10.3.1-10.3.15) **Safety analysis of petroleum activities on the Norwegian Continental Shelf.** Olshausen, K.D. (Scandpower A/S, Kjeller, Norway). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

the paper describes the safety work in connection with petroleum activities on the Norwegian Continental Shelf, as seen by one of the consultancy firms active in this field. After giving the main features of the regulatory background the approach chosen to conduct one of the main safety milestones, the so-called Conceptual Safety Evaluation (CSE), is described in some detail. Other safety work such as cost/benefit analyses, reliability analyses, and more detailed risk analyses during later stages of a project are also outlined.

2845 (NEI-FI—1, pp 11.2.1-11.2.18) **Hazard identification techniques as an aid in safety decision making. Quality improvements and acceptance criteria.** Taylor, J.R. (Oilconsult Engineers and Planners A/S, Birkeroed Denmark). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

In Denmark the approach to implementing the requirements of the European Community Major Hazards directive places emphasis on qualitative techniques, hazard identification and organization for safety. Safety analyses performed in this way however, give rise to several problems, such as how to decide whether the analysis is good enough and whether the results achieve a desired level of safety. Since the introduction of the requirements in Denmark in February 1986, the author and his colleagues have completed safety analyses of ten process plants intended for submission to the authorities for approval. All have required special approaches to the question of approval. Experience from these is described.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 2793, 2820, 2829, 2862, 2865, 2866, 2868

2846 (GAO/IMTEC—86-13) **Indian royalties: Interior has not solved Indian oil and gas royalty payment problems.** (General Accounting Office, Washington, DC (USA)). 1986. 50p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Bureau of Indian Affairs has fallen far behind in its responsibilities under the Federal Oil and Gas Royalty Management Act of 1982 in providing useful explanations of royalty payments to Indians. Among other things, royalties were not properly accounted for, resulting in overpayments; and Indian leases were received low priority in the agency's exception processing system, which bills royalty payers for late payments, nonpayments, underpayments, and insufficient estimates. A new computer is being installed in the Department of the Interior to improve the collection and disbursement of royalties but GAO found that this new computer will not solve the problems.

2847 (GAO/RCED—86-110) **Mineral revenues: Opportunities to increase onshore oil and gas minimum royalty revenues.** (General Accounting Office, Washington, DC (USA)). 1986. 29p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Mineral Leasing Act of 1920 provides that after discovery of oil or gas in paying quantities, federal onshore oil and gas lessees must pay annually a minimum royalty of $1 per acre. GAO found that since the Department of the Interior has not ensured the collection of all minimum royalties, as much as $1.7 million may have been undercollected for FY 1985. GAO also found that the $1 rate, legislatively established nearly 40 years ago as lowest amount charageable, has not kept pace with increased rental rates. GAO recommends that Interior recover uncollected or undercollected minimum royalties and related interested, and monitor existing leases to ensure that minimum royalties are paid. It is also recommends that the minimum royalty rate be adjusted.

2848 (GAO/RCED—86-158) **Strategic petroleum reserve: Low oil prices favor increased purchases.** (General Accounting Office, Washington, DC (USA)). 1986. 7p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy plans to stop filling the Strategic Petroleum Reserve in July 1986 as both a budget-cutting measure and because it believes sufficient oil will be stored to meet a 90-day contingency supply commitment to cover import disruptions. GAO believes it imprudent to suspend oil purchases given the circumstances of (1) low oil prices which are not expected to hold indefinitely, (2) nearly $580 million in the oil account, and (3) storage capacity which is or can be made available. GAO also believes that filling the SPR should continue at maximum rates to attain the statutory requirement for a 527-million-barrel inventory and then go beyond the requirement with an additional 73 million barrels which could be made available in FY 1987 with currently appropriated funds.

2849 (GAO/RCED—86-163FS) **Naval petroleum reserves: Sales procedures and prices received for Elk Hills oil.** (General Accounting Office, Washington, DC (USA)). 1986. 7p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Congress expressed concern about the Department of Energy's actions in selling oil from the Elk Hills Naval Petroleum Reserve at what appeared to be unreasonably low prices. DOE officials believe that Naval Petroleum Reserve oil has been and is currently being produced at the appropriate rate and that no recoverable oil has been lost. This fact sheet provides information on the basis for the procedures followed by DOE in selling Naval Petroleum Reserve oil and sales data for the period extending from October 1985 through April 1986.

2850 (GAO/RCED—86-169BR) **Naval petroleum reserves: Preliminary analysis of future net revenues from Elk Hills production.** (General Accounting Office, Washington, DC (USA)). 1986. 6p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This is an interim report on the present value of the net revenues from Elk Hills Naval Petroleum Reserve. GAO calculated alternative present values of the net revenues applying (1) low, medium, and high forecasts of future crude oil prices and (2) alternative interest rates for discounting the future net revenues to their present values. The calculations are sensitive to both the oil price forecasts and discount rates used; they are preliminary and should be used with caution. They do not take into account possible added tax revenues collected by the government if Elk Hills were sold nor varying production levels and practices, which could either increase or decrease the total amount of oil that can be extracted.

2851 (PMA—870520) **Report on the petroleum industry's reinvestment intentions following the early removal of the petroleum and gas revenue tax.** (Petroleum Monitoring Agency, Ottawa, Ontario (Canada)). 20 May 1987. 25p. (MICROLOG—87-03930). Petroleum Monitoring Agency, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In September 1986, the Minister of Energy, Mines and Resources announced that the Petroleum and Gas Revenue Tax would be eliminated October 1, 1986. The need to remove the tax resulted from the deteriorating financial situation of the Canadian petroleum industry following the collapse of oil prices in early 1986. This announcement followed assurances by industry organizations and representatives of major oil and gas producers that the savings from the revenue tax elimination would be reinvested in exploration and development activity. Periodic reports on industry reinvestment behaviour were to be submitted; this report begins that process.

2852 **National oil security policy. Hearing before the Subcommittee on Energy Regulation and Conservation of the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, June 2, 1987.** Washington, DC; Government Printing Office (1987). 549p.

Representatives of industry, the US Chamber of Commerce, the Citizen/Labor Energy Coalition, government agencies, and others testified at a hearing on the issue of reducing oil imports as a way to strengthen the domestic oil industry. An amendment to the trade bill that would impose an import fee on oil raised concerns that it might be counter-productive by causing hardship on individuals and other industries because of higher prices. Another concern was that the amendment relinquishes congressional power to tax and set policy to the president. The discussion covered the level of oil imports and changes in import activity at various points in history, although there was little consensus of interpretation. Oil marketers oppose the amendment on the ground that automatic triggers of import fees, quotas, and other strategies are unfair and economically risky. An appendix with additional material submitted for the record follows the testimony of the 14 witnesses.

0208 Waste Management

REFER ALSO TO CITATION(S) 2832

2853 **(CC—870121) Sampling and analysis of refinery effluents to assess variations in trace contaminants concentrations. A study.** (CANVIRO Consultants (Canada)). 21 Jan 1987. vp. (MICROLOG—87-05050). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This investigation was aimed at defining the capability of petroleum refinery biological treatment processes to effect trace contaminant removal and to assess the effluent quality variability. A comprehensive sampling program was carried out at two Ontario petroleum refineries. Six-hour flow-proportioned composite samples of the influent and effluent from the biological treatment plants at each refinery were collected on six occasions over a two-week period. During the sampling periods, biological system operating conditions and key refinery operating conditions were documented. The analytical program focussed on conventional contaminants, metals, selected volatile aromatic compounds, and polynuclear aromatic hydrocarbons. A comprehensive quality assurance program was conducted in conjunction with the sampling and analytical components of the investigation. Effluent quality was similar at both refineries with respect to trace organic contaminants despite significant difference in influent quality, refinery size and complexity, and biological treatment plant design and operation. Differences in effluent quality at the two refineries were apparent in the concentrations of conventional contaminants, total suspended solids, phenols, TKN, and ammonia nitrogen.

2854 **(ZE—850329) Evaluation of adsorbents for treating stable oil/water/mineral emulsions produced during in-situ bitumen/heavy oil recovery operations. Phase 2. Final report.** (Zenon Environmental, Inc., Burlington, Ontario (Canada)). 29 Mar 1985. 62p. (MICROLOG—86-4586). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objective was to make a preliminary assessment of the technical and economic feasibility of treating emulsions from in-situ bitumen/heavy oil recovery operations for recovery of the oil and preparation of suitable water for boiler feed utilizing adsorbents developed within the Separation and Characterization laboratory of Energy Mines and Resources Canada. This project was completed in two phases. In the first phase, a report was prepared which focussed on the characterization of the adsorption behaviour of the novel adsorbents, determination of an appropriate mode of operation and of the approximate cost for producing water for boiler feed. Three adsorbents (fly ash, red mud, Minto coal) were evaluated with respect to their potential for the treatment produced water. Fly ash and Minto coal were determined to have the best potential based on isotherms for total suspended oil (TSO) removal at two pH levels. The most appropriate mode of operation for these two adsorbents was slurry contact followed by precipitation clarification. During the second phase, work was focussed on the development and characterization of the slurry contact and clarification process for the treatment of produced water utilizing the novel adsorbents Minto coal and fly ash and the development of methods that could be used for the recovery of the adsorbed oil and regeneration of the spent adsorbents. The mechanism of oil removal by Minto coal was determined to be emulsion destabilization and precipitation caused by a coagulation type reaction with iron released from the coal, rather than an adsorbtion of oil on organics on the coal surface as originally believed. This study has shown that virgin Minto coal can effectively destabilize wellhead emulsions and that the oil can be separated from the destabilized emulsion by either precipitation or filtration. 3 figs., 15 tabs.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 2860, 2863

2855 **(AD-A—183941/4/XAB) New technology in oil-content monitors.** Nardella, J.A.; Raw, T.T.; Stokes, G.H. (Association of Scientists and Engineers of the Naval Sea Systems Command, Washington, DC (USA)). 1987. 32p. NTIS, PC A03/MF A01.

With legislation of international antipollution requirements to regulate the oil content of bilge effluent from ships, the U.S. Navy is installing pollution abatement equipment on all vessels. The equipment will consist of an oil/water separator in the bilge discharge line, followed by an oil content monitor which makes the final decision on whether or not the water is clean enough to be pumped overboard. The monitor is required to make a real time measurement of oil concentration in the range 15 + or - 5 to 100 + or - 20 ppm for flow rates up to 50 gal/min. and possibly in the presence of interfering contaminants, such as rust. This paper presents results of the current effort to develop a monitor which satisfies all these requirements and is sufficiently rugged for fleet deployment. The monitor employs two fiber optic systems and a small microprocessor. The first optical system measures the concentration of particles in the flow as function of their sizes, using small angle forward scattering. The second determines what percentage of the particles in the flow are oil, using large-angle scattering. The microprocessor takes these data and calculates the oil concentration in the flow.

2856 **(GAO/RCED—86-80FS) Air pollution: EPA's efforts to reduce and end the use of lead in gasoline.** (General Accounting Office, Washington, DC (USA)). 1986. 6p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency has relied on data generated by the U.S. Army and U.S. Postal Service to support its lead phasedown program. Both organizations had switched large fleets of vehicles from leaded to unleaded gasoline and experienced no mechanical or operating problems. In response to concerns expressed by the Congress, the Department of Agriculture, and the farm community about the impacts of low-lead gasoline or its possible ban on farm equipment, EPA agreed to reevaluate the standards. EPA expects that by January 1987, it will determine whether the low-lead standard needs to be changed to prevent adverse effects on farm machinery and what the final action should be on its proposal for a ban.

2857 **(GAO/RCED—86-182) Vehicle emissions: EPA program to assist leaded-gasoline producers needs prompt improvement.** (General Accounting Office, Washington, DC (USA)). 1986. 30p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency, in reducing the lead content of gasoline, established a lead banking regulation for 1985-1987 which was designed to assist those participants who needed to upgrade their equipment in order to meet the more stringent standards. EPA has established a system of controls over the lead rights banking program to identify mathematical errors and violations of regulatory requirements that can be ascertained by reviewing participants' reports. However, EPA has not established a requirement to verify the data submitted, nor has it completed its review and processing of the reports for the first year of the program, which ended December 1985. Neither has it taken enforcement actions. These lax controls could result in the use of lead in amounts exceeding allowed levels.

2858 **(NP—8750152) Experiments on models for an oil retention and collecting device.** Geistert, K. (Versuchsanstalt fuer Wasserbau und Schiffbau, Berlin (Germany, F.R.)). 10 Dec 1985. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750152/JAW.

Experiments were carried out on a model to investigate the resistance and performance at sea in transit and operational states of a linked composite system consisting of an oil-collecting barge and two chains of floats to form a retaining barrier according to a

Jebsen patent. The results make it possible to make statements about the suitability of the system for its intended purpose, and to draw comparisons with conventional devices and equipment.

2859 **(PB—87-221032/XAB) Evaluation of air-pollution regulatory strategies for the gasoline-marketing industry - response to public comments. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1987. 329p. (EPA—450/3-84/012C). NTIS, PC A15/MF A01.

See also Executive Summary, PB—84-231083.

The gasoline-marketing industry (bulk terminals, bulk plants, service-station storage tanks, and service-station vehicle-refueling operations) emit to the atmosphere several organic compounds of concern. These include: volatile organic compounds (VOC), which contribute to ozone formation; benzene, which has been listed as a hazardous air pollutant based on human evidence of carcinogencity; and gasoline vapors, for which there is animal evidence of carcinogencity. This document provides a summary of EPA responses to public comments on environmental and economic analysis published by EPA in 1984 (EPA-450/3-84-012a and b). Changes made to EPA's 1984 analysis in response to public comments, additional analyses performed, and a summary of the results are contained in a separate two-volume draft Regulatory Impact Analysis document (EPA-450/3-87-001 a and b).

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 2824, 2852, 2856, 2857, 2861, 2862

2860 **(PNL-SA—15065) Federal decisions and industry participation: The case of offshore oil leasing.** Klan, M.S.; Englin, J.E. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 24p. (CONF-8707123—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000989/JAW.

From Western Economic Association international conference; Vancouver, Canada (7 Jul 1987).

Prior empirical work in the economics of offshore oil and gas leasing assumes the ocean area offered by the US government for leasing to be given. Analysis typically proceeds by examining the firms' behavior in bidding and operating on the area offered. The present research looks at the decision made by the government to offer or withdraw specific parcels (called blocks) from the leasing process. The choices by firms to bid upon the offered-set of blocks are then examined. The key linkage between the decisions appear to be the expected environmental damage associated with exploiting the block. The paper begins with a background section, which briefly outlines the leasing process, examines the role of environmental information, and places the present work in the context of the literature. Section 2.0 provides a conceptual model of the federal offering decision and the industry bidding decision. The next section provides a case study and associated empirical analysis. A summary and conclusion are then given. 30 refs., 3 figs., 3 tabs.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 2858, 2905, 2906, 3796

2861 **(NEB-SS—22-1/1987-7E) Reasons for decision. Trans-Northern Pipelines Inc. application dated 11 March 1987 for new tolls effective 1 February 1987.** (National Energy Board, Ottawa, Ontario (Canada)). Jul 1987. 31p. National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

Trans-Northern Pipelines Inc. owns and operates a pipeline for the transportation of refined petroleum products that extends from Nanticoke on Lake Ontario to Montreal, Quebec. The National Energy Board has issued an order setting new tolls to be charged by Trans-Northern Pipelines Inc., effective September 1, 1987, for the transportation of refined petroleum products. The new tolls are on average 2.3% less than the existing interim tolls in effect since February 1, 1987. As a result, Trans-Northern is required to refund to its shippers the excess revenue it has collected since the interim tolls have been in place, together with carrying charges. The refund will be in the order of $370,000. The tolls are designed to recover a revenue requirement of $24.7 million, which is $0.4 million less than what Trans-Northern had applied for in March of this year. The Board has approved a rate of return on equity of 13.75% compared with a rate of 14.75 requested and a previously approved rate of 15.75%. The equity component in the capital structure remains relatively unchanged at about 50%. Detailed financial data are included. 10 tabs.

2862 **(NEB-SS—22-1/1987-7F) Motives for decision. Trans-Northern Pipelines Inc. order dated March 11, 1987 concerning new tolls required to charge since February 1, 1987.** (Office Nationale de l'Energie, Ottawa, Ontario (Canada)). Jul 1987. 31p. (In French). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

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2863 (NEI-FI—1, pp 8.3.1-8.3.10) **Tanker incidents probability as a basis for environmental emergency planning.** Vesterfaard, N.K.; Taylor, J.R. (Risoe National Lab., Roskilde Denmark; Oilconsult Engineers and Planners A/S, Birkeroed, Denmark). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

A probabilistic assessment has been performed as part of a project for giving a better contingency plan for tanker and pipeline accidents, causing pollution problems in Thailand. The assessment was based on ship collision and stranding theories by Fujii et al. and Macduff. The theories and their application to Thai waters are described and compared to reported statistics. The probabilistic results were found to be in good agreement with world wide statistics on reported tanker casualties.

0230 Properties

REFER ALSO TO CITATION(S) 2838, 3817

2864 **(PCPP/RD—8602) The compositional study of nitrogen and oxygen compounds in products of heavy oil primary and secondary upgrading processes. Final report.** Chmielowiec, J. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). Feb 1986. 61p. (MICROLOG—86-05092). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The primary objective was to characterize nitrogen and oxygen compound types in the upgraded products derived from Athabasca bitumen. Nitrogen compounds, depending on their nature and concentrations, in charge stocks to catalytic processess (hydro-processes and reforming) can severely limit or poison the catalyst activity. Oxygen compounds are corrosive (especially naphthenic acids) and can promote gum formation as part of the deterioration of the hydrocarbons in the petroleum product. A secondary objective was to evaluate the advantages and limitations of in-house mass spectrometry and infrared spectroscopy methods for

analyzing specific classes of polar compounds in naphthas, middle distillates, and gas oils. An analytical procedure that was based on the discrimination of polar compound classes using liquid chromatography followed by mass spectrometric analysis was tested. The chemical intelligence on the fractions obtained from Athabasca bitumen and its upgrading products has been advanced by determining structural characteristics of the nitrogen and oxygen components. This report describes the determination of the distributions of nitrogen and oxygen compounds in samples from various process streams. This procedure is capable of providing information useful for evaluating hydrodenitrogenation and hydrodeoxygenation reactions.

0240 Storage

REFER ALSO TO CITATION(S) 2848

2865 **(GAO/RCED—86-205) Oil reserve: Status of Strategic Petroleum Reserve activities as of June 30, 1986.** (General Accounting Office, Washington, DC (USA)). 1986. 29p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The administration has no official plans to revise the moratorium-based FY 1987 Strategic Petroleum Reserve budget submitted in February 1986, to recognize congressional actions affecting SPR development and oil fill. As of June 1986 the Department of Energy planned to stop oil fill at 503 million barrels but as a result of GAO recommendations concerning continued SPR storage capacity development and oil fill purchases, DOE added 4.9 million barrels of crude oil to the SPR, bringing the total inventory level to 501.8 million barrels. The oil fill rate averaged 53,800 barrels per day. Also as of June 1986, payments made from the oil acquisition and transportation account during the quarter totaled $63 million; unpaid obligations totaled $63 million; and unobligated funds available for oil purchases totaled $590 million. DOE has taken or planned various corrective actions for improving future SPR sales as a result of DOE's assessment of the results of the recently conducted oil drawdown test and scale exercise.

2866 **(GAO/RCED—87-49) Oil reserve: Status of strategic petroleum reserve activities as of September 30, 1986.** (General Accounting Office, Washington, DC (USA)). 1987. 26p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report covers activities related to the Department of Energy's progress in developing, operating, and filling the Strategic Petroleum Reserve during FY 1986. Some of the highlights are (1) funds apportioned in the oil account for FY 1987 to provide for a purchase level of 35,000 barrels of crude oil per day at an estimated cost of $16.45 per barrel; (2) DOE plans to acquire 8,000 barrels of oil per day from the Naval Petroleum Reserve and transfer it by pipeline from Bakersfield, California, to the West Hackberry, Louisiana SPR storage site with total delivered costs to be about $16 per barrel; (3) the decision whether to acquire additional crude oil from Mexico beyond purchases to be made through Oct. 31, 1986; and (4) as of Sept. 30, 1986, the SPR inventory totaled 506.4 million barrels. During the quarter DOE added 4.6 million barrels of crude oil to the SPR. The oil fill rate during the quarter averaged about 50,000 barrels per day.

2867 **(GAO/RCED—87-101FS) Oil reserve: Status of Strategic Petroleum Reserve activities as of December 31, 1986.** (General Accounting Office, Washington, DC (USA)). 1987. 26p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy said that the FY 1988 Strategic Petroleum Reserve budget does not provide funds for developing oil storage capacity beyond 580 million barrels. DOE's progress in developing, operating, and filling the SPR and in complying with the applicable law are highlighted, in this fact sheet as follows: As of Dec. 1986, the SPR inventory totaled 511.6 million barrels of oil and during the quarter DOE added about 56,300 barrels per day; for FY 1987, DOE did not request additional appropriated funds for oil-fill acquisition; the FY 1988 budget request of $270 million proposes an oil-fill acquisition rate of 35,000 barrels per day; DOE signed agreeements with Transworld Oil U.S.A., Inc., to purchase 3.65 million barrels of domestically produced oil and with PEMEX for 23.7 million barrels of oil; and Boeing, the prime contractor for the management, operation, and maintenance of the SPR, was awarded 65 percent of the $2.6 million award fee available for the second 6-month award fee period.

2868 **(GAO/RCED—87-145BR) Oil reserves: An analysis of oil fill alternatives.** (General Accounting Office, Washington, DC (USA)). 1987. 51p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy is planning to obligate about $670 million in FY 1987 to develop and manage the Strategic Petroleum Reserve, increase storage capacity to 581 million barrels, and fill the reserve at a 75,000 barrel-per-day rate. It is also planning to stop developing additional storage capacity through its cavern leaching program after which SPR will have about 47 million barrels of storage capacity available for fill in FY 1988. Lower oil fill rates would increase the time needed to fill available capacity and would probably increase the total oil costs. Continued leaching to increase oil storage space would add about $22.4 million to DOE's proposed FY 1988 budget and $118 million during FY 1989-1992. GAO concluded that it is generally less costly to the government to fill the SPR at the maximum rate as fast as capacity is developed.

0250 Combustion

REFER ALSO TO CITATION(S) 4070

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 2820

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 2820, 2821

2869 **(CONF-8705179—) Research needs for hydrocarbon fuels.** (USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences). 1987. Contract FG05-84ER13228. 116p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE87014555/JAW.

- From Workshop on not yet visible or recoverable hydrocarbons; Woodland, TX, USA (11 May 1987).

A DOE sponsored workshop was held early in May, 1987, at the Houston Area Research Center, Texas, to outline research requirements for enhancing future domestic production of hydrocarbons. Not only was the result a large number of suggested research programs and themes but, in addition, several central recommendations emerged. A matrix format for the meeting was chosen in which the workshop members were divided among eight thematic panels: (1) new ways to study the earth; (2) deep gas; (3) the subtle, complex and hard-to-see traps; (4) mapping source beds and seals; (5) new settings for exploration; (6) reservoir characterization; (7) reservoir mechanisms and transport properties; (8) reservoir management; and among the cross-cutting disciplines of geology, geochemistry, geophysics, and petroleum engineering. Most of the allotted time was spent in the thematic panels. Reporting of the tentative findings of the thematic panels was accomplished during a plenary session and those findings were reviewed when the members reconvened and respond to the contribution of the cross-cutting disciplinary groups. These panel reports are presented in Appendix A of this report.

2870 **(DOE/MC/20422—2301) Geologic characterization of tight gas reservoirs: FY86 USGS annual report, October 1, 1985-September 30, 1986.** Law, B.E.; Spencer, C.W.; Lickus, M.R.; Pollastro, R.M.; Johnson, R.C.; Nuccio, V.F.; Pitman, J.K. (Geological Survey, Denver, CO (USA)). Sep 1986. Contract AI21-83MC20422. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87001083/JAW.

The objectives of US Geological Survey work are to conduct geologic research characterizing tight gas-bearing sequences in the western United States. The USGS research during the last few years has been in the Greater Green River, Piceance Creek, and Uinta basins of Wyoming, Colorado, and Utah. Additional critical objectives are to provide geologic consulting and research support for ongoing Multiwell Experiment (MWX) engineering, petrophysical, log-analysis, and well-testing research. Within these basins our research efforts have been regional in scope. The Greater Green River basin has high priority because most of the Piceance basin studies have been completed or are being completed, and because the Greater Green River basin has the greatest areal extent and greatest known thicknesses (>10,000 ft) of strata containing dominantly gas-bearing sandstone reservoirs. The Uinta Basin may have greater thicknesses of tight-gas strata, but there are presently no wells that have been drilled through the Cretaceous Mesaverde Group in the deeper parts of the basin. The objectives of these focused investigations are to provide geologic models that can be compared and utilized in tight gas-bearing sequences elsewhere. 18 figs.

2871 **Effects of gas composition and geothermal properties on the thickness and depth of natural-gas-hydrate zones.** Holder, G.D.; Malone, R.D.; Lawson, W.F. (Chemical and Petroleum Engineering Dept. at the Univ. of Pittsburgh, PA). *Journal of Petroleum Technology;* **39**: No. 9, 1147-1152(Sep 1987).

When natural gas and water contact at low temperature and high pressure, gas hydrates can form. In colder climates (such as Alaska, Northern Canada, and Siberia) and beneath the oceans, conditions are appropriate for gas-hydrate formation. This paper gives the depths and potential thicknesses of such hydrate formations as a function of the geothermal gradient, gas composition, and where appropriate, permafrost thickness, pressure gradient, and ocean-bottom temperature.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 2820, 2824, 2827

2872 **(PB—87-232153/XAB) Production waters associated with the production, processing, transmission, and storage of natural gas: a literature survey. Topical report, July 1985-March 1987.** Fillo, J.P.; Hamacker, T.A.; Koraido, S.M.; Stefanacci, R.G.; Tallon, J.T. (ERT, Pittsburgh, PA (USA)). Jul 1987. 301p. NTIS, PC A14/MF A01.

This report presents a review of the available public literature on the sources, characteristics, and management of production waters from natural gas industry operations. Gas exploration, production, processing, transmission, and storage operations generate production waters that must be discharged or disposed in accordance with applicable environmental regulations. Disposal practices and regulations are coming under increased scrutiny by EPA for all industry, and regulatory changes are anticipated in the foreseeable future. Natural gas industry operations will be affected to some degree by potential changes in regulations governing management of production waters under RCRA, the UIC program of the SDWA, and biomonitoring requirements for NPDES discharges under the CWA. The availability of data on production-water composition, biomonitoring, treatment, and disposal practices varies widely in the public literature. While chemical composition data are available for drilling fluids and produced waters, comprehensive detailed chemical analyses generally are not. Biomonitoring data are available only for drilling fluids, with few exceptions.

0304 Products And By-products

2873 **(SNC/TD—8503) Conceptual design and techno-economic assessment of three electricity-based reactor processes for production of liquid fuels and/or hydrocarbons from natural gas.** (SNC Group, Montreal, Quebec (Canada). Technical Development Dept.). Mar 1985. 128p. (MICROLOG—86-05133). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study has been carried out to investigate the feasibility of liquid fuel (gasoline) and/or hydrocarbon (acetylene and ethylene) production from natural gas via the novel acetylene route using the following designated electricity-based acetylene reactors: electric-arc reactor, preheated or hydrogen plasma reactor, resistance-heated type. The proposed scheme involves utilization of both natural gas and electricity to produce the desired products. A summary of techno-economic results is presented.

0305 Health And Safety

REFER ALSO TO CITATION(S) 2905, 2906

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 2820, 2843, 2846, 2847, 2901, 2903, 2907, 2908, 4073

2874 **(APUB—870825) Decision re: natural gas transportation rates inquiry.** (Alberta Public Utilities Board, Edmonton (Canada)). 25 Aug 1987. vp. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

Decision C87014 dated August 25, 1987 before the Public Utilities Board, Alberta, ordered that the rates, tolls, and charges included in this document for Canadian Western Natural Gas Company Limited (CWNG) and Northwestern Utilities Limited (NUL) were fixed and approved charges for transportation service effective September 1, 1987. The Natural Gas Transportation Service Regulations as filed by CWNG and NUL were approved subject to the filing of necessary amendments to comply with the specific directions of the Board.

2875 **(APUB—E87002) Decision E87002 before the Public Utilities Board of Alberta re: Northwestern Utilities Limited in the matter of a general rate application, pursuant to the Public Utilities Board Act, RSA 1980, c. P-37 and the Gas Utilities Act, RSA 1980, c. G-4, both as amended.** (Alberta Public Utilities Board, Edmonton (Canada)). 6 Feb 1987. 293p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

Northwestern Utilities Limited filed an application dated May 15, 1984 with the Public Utilities Board to determine a rate base for service within Alberta and to fix and approve rates for natural gas utility service supplied by Northwestern. The Board decided that the application hearing would proceed in two parts: Phase I to examine the forecast total revenue requirements of Northwestern Utilities for the test years of 1984 and 1985, and Phase II to examine proposed rates, tolls, or charges to raise the total revenue requirements. Each phase was to be again divided into two parts. This document deals with Northwestern's calculation of its forecast Utility Rate Base, its total Utility Revenue Requirement for the test years, the analysis of its 1984/1985 actual results, and the Board's findings thereof.

2876 **(APUB—E87015) Order E87015 dated February 27, 1987 re: ICG Utilities (Alberta) Ltd. in the matter of an order pursuant to section 50(1) of the Public Utilities Board Act approving a decrease in the rates of ICG Utilities (Alberta) Ltd.** (Alberta Public Utilities Board, Edmonton (Canada)). 27 Feb 1987. 28p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Public Utilities Board, Alberta, approved a decrease in rates of ICG Utilities (Alberta) Ltd. with respect to all consumption on and after March 1, 1987 based on actual or estimated meter readings. The interim rates are subject to change by the Board. These rates replace rates fixed October 31, 1986 (E86084). Schedules are included to further specify conditions of service for the various utilities.

2877 **(APUB—E87024) Decision E87024 dated April 14, 1987 re: Northwestern Utilities Limited in the matter of an application to fix rates, tolls, charges, or schedules thereof for natural gas utility service for the test years 1984 and 1985.** (Alberta Public Utilities Board, Edmonton (Canada)). 14 Apr 1987. 59p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

Phase I Decision E87002 by the Public Utilities Board, Alberta, determined and approved Northwestern Utilities Limited (NUL)'s rate base, fair return on rate base, Utility Revenue Requirement, and revenue deficiencies for the test years 1984 and 1985. Order E87009 amended the decision. This document addresses the rates, tolls, or charges to be applied to consumption on and after May 1, 1987 with regard to cost of service study, rate design, revenue shortfall and deficiency rider, and pressure surcharges, and discusses the Board's findings thereof.

2878 **(APUB—E87032) Order E87032 dated April 22, 1987 re: Northwestern Utilities Limited in the matter of an application by Northwestern Utilities Limited for an order of the Public Utilities Board approving a reduction of Rate Rider "C" on an ex parte basis under section 54 of the Public Utilities Board Act.** (Alberta Public Utilities Board, Edmonton (Canada)). 22 Apr 1987. 7p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Public Utilities Board, Alberta, approved a decrease in Rate Rider "C" for non-rebateable sales, i.e. sales not subject to rebate under the National Gas Debates Act, 1980 to Northwestern Utilities, effective on gas consumption on and after April 1, 1987 based on actual and estimated readings. These rates replace those Rate Rider "C" approved in Decision E87024.

2879 **(APUB—E87033) Order E87033 dated April 22, 1987 re: Canadian Western Natural Gas Company Limited in the matter of an application by Canadian Western Natural Gas Company Limited for an order of the Public Utilities Board approving a reduction of Rate Rider "C" on an ex parte basis under section 54 of the Public Utilities Board Act.** (Alberta Public Utilities Board, Edmonton (Canada)). 22 Apr 1987. 7p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Public Utilities Board, Alberta, approved a decrease in Rate Rider "C" for non-rebateable sales, i.e. sales not subject to rebate under the Natural Gas Rebates Act, 1980 to Canadian Western Natural Gas Company Limited, effective on gas consumption on and after April 1, 1987. These rates replace those Rate Rider "C" approved in Decision C86033.

2880 **(APUB—E87051) Interim order dated July 3, 1987 re: Northwestern Utilities Limited in the matter of an application by Northwestern Utilities Limited for approval to reduce gas sales rates and to establish a procedure for reconciling gas cost components.** (Alberta Public Utilities Board, Edmonton (Canada)). 3 Jul 1987. 20p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Northwestern Utilities Limited was ordered by the Public Utilities Board, Alberta, to observe the interim rates imposed with respect to all consumption on and after July 1, 1987, based on actual or estimated meter readings. These rates replace those approved in Order E87024 and amended Order E87032. Financial data are included.

2881 **(APUB—E87052) Interim order E87052 dated July 3, 1987 re: Canadian Western Natural Gas Company Limited in the matter of an application by Canadian Western Gas Natural Gas Company Limited for approval to reduce gas sales rates and to establish a procedure for reconciling gas cost components.** (Alberta Public Utilities Board, Edmonton (Canada)). 3 Jul 1987. 29p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Canadian Western Natural Gas Company Limited was ordered by the Public Utilities Board, Alberta, to observe the approved interim rates with respect to all consumption on and after July 1, 1987, based on actual or estimated meter readings. These rates replace those approved in Order E86033 and amended by Order E87033. Financial data are included.

2882 **(CGA—8704) Canadian gas rates.** (Canadian Gas Association, Don Mills, Ontario). Apr 1987. 99p. Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $25.00 CAN.

This document was prepared by the Canadian Gas Association to be used as a guide in rate structure to the gas distribution, transmission, and production companies and appliance manufacturers. The data have been compiled by province.

2883 **(CONF-8611194—) TA Luft (Clean Air Technical Guide) - a chance for natural gas? Proceedings.** (Arbeitsgemeinschaft fuer Sparsamen und Umweltfreundlichen Energieverbrauch e.V. (ASUE), Frankfurt am Main (Germany, F.R.)). Nov 1986. 169p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

7 papers were presented at the ASUE working group 'Natural gas and the environment' in November 1986, which deal with the TA Luft (Clean Air Technical Guide) requirements made on natural-gas-fuelled firing installations in boiler plants and industrial processes as well as in I.C. engines and turbines. They all draw the conclusion that the stipulated limit values can be met and that natural gas will remain competitive in the light of pollution control. The 7 papers were entered separately. (HSCH).

2884 (CONF-8611194—, pp 47, Paper 2) **Natural gas in boiler plants (new plants).** Bihler, M. (Ruhrgas A.G., Essen, Germany, F.R.). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

The question 'is the Clean Air Technical Guide a chance for natural gas' can be answered in the affirmative at least in part for the field of new boiler combustors. The benefits of natural gas with its absence of dust and sulphur and its good combustion properties will strengthen the market position of this fuel. Natural gas as fuel will still offer the best prerequisites even if requirements were made which would be more stringent than those of the Clean Technical Guide. (orig./HSCH).

2885 (CONF-8611194—, pp 13, Paper 3) **Impact of the 1986 Clean Air Technical Guide on existing boiler plants.** Hering, S. (Westfaelische Ferngas-A.G., Dortmund, Germany, F.R.). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

The variety of existing plants and their different conditions of operations require that the individual measures resulting from the application of the 1986 Clean Air Technical Guide, and their cost will have to be established for each case separately. Compared to other fuels, however, the combustion of natural gas causes the least cost owing to its cleanness and good combustion properties. Natural gas will succeed in enhancing its competitive edge in the heat market. (orig./HSCH).

2886 **(DOE/EIA—0130(87/07)) Natural gas monthly, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 1 Oct 1987. 157p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88002159/JAW.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the US are provided for each year from 1981 through June 1987 with monthly data for the most recent three years. Some data are also given by State or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under theNatural Gas Policy Act of 1978, are also included. Featured articles for this month are: "Underground Storage of Natural Gas"; and "Domestic Natural Gas Reserves and Production Dedicated to Interstate Pipeline Companies, 1986." 13 figs., 47 tabs.

2887 **(MPUB—71/87) ICG Utilities (Manitoba) Ltd. and Greater Winnipeg Gas Company application for an interim ex parte order under section 45 of the Public Utilities Board Act for the approval of criteria for buy/sell agreements.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 15 Apr 1987. 3p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

The Public Utilities Board directed ICG Utilities (Manitoba) Ltd. and Greater Winnipeg Gas Company, in Order 158/86 to develop and submit for approval a list of criteria and requirements for the implementation of Buy/Sell service. In this Order the Board approved the criteria on an interim basis provided that the Companies do not levy penalties or charges for administration costs and that the Companies do not require the installation of telemetry equipment during the interim period. The Board also ordered that the Companies prepare a report detailing the reasons for the various criteria and that the draft Buy/Sell Agreement be utilized pending final consideration of the proposed criteria.

2888 **(MPUB—89/87) Public hearing to inquire into the gas applications of Greater Winnipeg Gas Company and ICG Utilities (Manitoba) Ltd. for an order or orders approving a change in rates and other matters.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 13 May 1987. 27p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

In December, 1986 the Greater Winnipeg Gas Co. and ICG Utilities (Manitoba) Ltd. applied to the Public Utilities Board of Manitoba for a change in rates to be charged by the Companies for the sale of gas. Also in December, 1986 the Minister of Consumer and Corporate Affairs of Manitoba requested the Board investigate all matters relating to the cost of gas and its provision to Manitoba customers at competitive prices. Public hearings respecting both the rates charged and the Ministerial Inquiry were held in February and March, 1987. This Order deals with only the applications of the Companies for rate changes. The Board ordered that the rates applied for be in effect from June 1, 1987 to October 31, 1987, and that they reflect a reduction in cost from November 1, 1987 to October 31, 1987.

2889 **(MPUB—97/87) Greater Winnipeg Gas Company application for approval of rates flowing from Board Order No. 89/87.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 5 Jun 1987. 6p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

Order No. 89/87, May 13, 1987, required that the Greater Winnipeg Gas Company calculate and present to the Public Utilities Board of Manitoba a revised schedule of rates. The rates were determined by applying certain adjustments approved by Order No. 97/85. The adjustments provide a decrease to the existing rates during June 1 to October 31, 1987. The Board approved the revised schedule.

2890 **(MPUB—98/87) ICG Utilities (Manitoba) Ltd. application for approval of rates flowing from Board Order No. 89/87.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 5 Jun 1987. 13p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

Order No. 89/87, May 13, 1987, required that ICG Utilities (Manitoba) Ltd. calculate and present to the Public Utilities Board of Manitoba a revised schedule of rates. The rates were determined by applying certain adjustments approved by Order No. 97/87. The adjustments provide a decrease to the existing rates during June 1 to October 31, 1987. The Board approved the revised schedule.

2891 **(MPUB—123/87) Relating to the Greater Winnipeg Gas Company application for an order determining rate base, rate of return and rates based on a 1986 historical test year.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 10 Aug 1987. 61p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

The Greater Winnipeg Gas Company (GWG) applied for a rate increase from 12.65% to 12.75%, a revenue requirement of $221,519,400, and a change in its rate structure. This is the first rate base, rate of return application filed by GWG since it had been purchased by Inter-City Gas Corporation. The Board approved of an overall rate of return of 12.35% and a revenue requirement of $219,261,060. The company was ordered to redo its rate structure.

2892 **(MPUB—128/87) Buy/sell agreements between ICG Utilities (Manitoba) Ltd. and Her Majesty the Queen in right of the province of Manitoba.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 31 Aug 1987. 26p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

ICG Utilities (Manitoba) Ltd. submitted two proposed Buy/Sell Agreements for approval by the Public Utilities Board of Manitoba covering the Saskatchewan zone and Manitoba zone of the province of Manitoba. The Agreements were approved by the Board and stipulations set out. The Agreements, unless renewed, terminate on the 31st day of October, 1988.

2893 **(MPUB—129/87) In the matter of clarification of Board Order Nos. 89/87 and 97/87.** (Manitoba Public Utilities Board, Winnipeg (Canada)). 2 Sep 1987. 2p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $N/C.

The Public Utilities Board of Manitoba issued Board Orders Nos. 89/87 and 97/87. Board Order No. 97/87 approved a new schedule of rates effective June 1, 1987 resulting from a decrease in the cost of gas November 1, 1986. This new schedule complied with instructions issued to the company in Board Order No. 89/87. The intent of Order No. 97/87 was to cover all methods of repayment including rebates of excess payments prior to the implementaion of the new rate schedules. The rebate has been deemed to be part of the rates in effect from June 1, 1987.

2894 **(MPUB—8704) Report on the impact on Manitoba consumers of deregulation of natural gas pricing in Canada.** (Manitoba Public Utilities Board, Winnipeg (Canada)). Apr 1987. 48p. Manitoba Public Utilities Board, 405 Broadway Ave., Rm. 1146, Winnipeg, Man., Canada R3C 3L6; $5.00 CAN.

This report was prepared in response to the written request of the Minister of Consumer and Corporate Affairs of Manitoba that the Public Utilities Board inquire whether the present cost of natural gas exceeds the competitive market price and whether current arrangements affecting the cost of natural gas will give Mani-

toba consumers competitive gas prices in the future. Following thirteen days of public hearings, the Board arrived at a number of conclusions presented in this report. The principal constraints to a free competitive market of natural gas are identified and evidence indicates deregulation will be a slow process evolving over a period of years. Evidence and conclusions are discussed from the perspectives of both the competitive market price and security of future gas supply.

2895 **(NEB-SS—870212F) Reasons for decision. Westcoast Transmission Company Limited. Application dated February 12, 1987 for interruptible sales toll on gas exportation.** (Office National de l'Energie, Ottawa, Ontario (Canada)). Apr 1987. 10p. (RH—1-87). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

Westcoast Transmission Company Limited was directed in August 1986 to file an export interruptible sales toll as part of its final tariff and to include any revenues from the application of this toll in a deferred account for final disposition at the next toll proceeding. In October 1986, Westcoast requested this toll be deleted. The Board denied the request. Presented are evidence and reasons as to why the Board found the toll necessary, the distinctions made between marketing and transportation roles, and the approved disposition of the toll revenues.

2896 **(PB—87-235719/XAB) Potential value of climate forecasts to the natural gas industry in the United States. Final report, December 1984-December 1986.** Brown, B.G.; Murphy, A.H. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Aug 1987. 198p. (SCIL—87-2). NTIS, PC A09/MF A01.

Natural-gas-company operations are significantly affected by weather conditions. In particular, operational decisions may be influenced by conditions one or several months in the future. Effective use of currently available - or improved - climate (e.g., monthly, seasonal) forecasts could potentially result in important operational cost savings by individual gas companies. Interviews and questionnaires involving a large number of gas companies were used to evaluate possible uses of climate forecasts by individual gas companies and to estimate the potential economic value of such forecasts to those companies. Five areas were identified in which climate forecasts might be of particular utility to gas transmission and/or distribution companies: (1) gas storage; (2) gas supply; (3) service/sales to interruptible customers; (4) maintenance; and (5) cash flow management.

0307 Waste Management

REFER ALSO TO CITATION(S) 3588

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 2872

2897 **(NP—8750149) Natural gas alternative. Collected facts and figures. Rev. Ed .** (Arbeitsgemeinschaft fuer Sparsamen und Umweltfreundlichen Energieverbrauch e.V. (ASUE), Frankfurt am Main (Germany, F.R.)). Nov 1986. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750149/JAW.

The publication informs about the natural gas alternative. Its different sections deal with combustion processes, the major pollutants, the present state and development of harmful environmental effects caused by air pollution which are relevant to the energy sector, the dispersion, conversion and effects of pollutants, pollution abatement measures, pollution laws and pollution regulations, comparative evaluation of heating systems. The appendix gives access to a bibliography, to diagrams and tables as well as to conversion factors and formulae. (HSCH).

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 2869

2898 **(PB—87-232666/XAB) Geologic assessment of natural gas from coal seams in the Piceance Basin, Colorado. Topical report, September 1985-September 1986. Final geologic report.** McFall, K.S.; Wicks, D.E.; Kuuskraa, V.A.; Sedwick, K.B. (Lewin and Associates, Inc., Washington, DC (USA)). Nov 1986. 115p. NTIS, PC A06/MF A01.

To evaluate the natural gas potential of coal seams in the major coal groups of the Piceance Basin (Colorado), an analysis of the subsurface geology of the Black Diamond, Cameo, and Coal Ridge of the Iles and Williams Formations was completed along with new correlations of gas content to coal rank and depth. Natural gas in place is estimated to be 84 TCF (Cameo Group, 65 TCF; Coal Ridge Group, 10 TCF; and Black Diamond Group, 9 TCF). Within the Cameo Group, the A and D seams account for about half or 38 TCF of the gas in place. The most-concentrated areas of methane in place are in the east-central portion of the Piceance Basin around the Divide Creek Anticline and Grand Hogback Monocline, areas which have thick accumulations of high-rank coals and appear to have been tectonically altered.

2899 **Fracture diagnostics results for the first Multiwell Experiment's paludal zone stimulation.** Hart, C.M.; Engi, D.; Fleming, R.P.; Morris, H.E. (Sandia Natl. Labs.). *SPE (Society of Petroleum Engineers) Formation Evaluation;* **2**: No. 3, 320-326(Sep 1987).

A dual seismic system designed to monitor the growth of hydrofractures was fielded during the first stimulation at the U.S. DOE-sponsored Multiwell Experiment (MWX) during Dec. 1983. The MWX consists of three 8,000-ft [2438-m] wells drilled in low-permeability gas reservoirs. The wellbores are spaced less than 200 ft [61 m] apart over most of their length. With this configuration, microseismic activity created by the fracture treatment in one well could be observed with downhole geophone packages in the two adjacent wells. Responses of the two triaxial borehole seismic tools (BST's) were monitored in real time. Upon detection of a seismic event of known location, orientations of the BST's were determined from the polarization of the compressional wave arrivals. From knowledge of the horizontal and vertical angles of incidence and an empirical estimate of seismic velocities, the locations of the fracture-induced seismic sources were estimated. Thus the location of the microseisms could be estimated and, in turn, the fracture height and extent inferred. This paper presents the results of fracture diagnostics by use of this borehole seismic system for the first MWX stimulation. This information is compared and combined with the results obtained from other diagnostic techniques to provide an integrated estimate of the fracture geometry resulting from the stimulation.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 2824, 2875, 2877, 2878, 2879, 2880, 2881, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2894, 2895, 2907, 2908, 4338

2900 **(ERCB/C—870120) Notice of motion. Sulpetro Limited.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 20 Jan 1987. 4p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

Sulpetro Limited submitted an application for approval to implement design modifications at Elmworth gas processing plant, to allow operation of the plant at an increased gas through-put rate and an increased ethane recovery efficiency. The Board decided to consider the application at a public hearing in January 1987. Alberta Gas Ethylene Company Ltd. (AGEC) included a report evaluating issues in its intervention. Sulpetro moved to have certain sections of the report struck out. The Board held a pre-hearing meeting to discuss the motion. Views of the participants are included with the decision of the Board that those report sections could not be considered irrelevant and that a portion of the evidence may be irrelevant.

2901 **(MEM—87) Manitoba's natural gas policy. Energy security at a fair price.** (Manitoba Ministry of Energy and Mines, Winnipeg (Canada)). 1987. 7p. Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., Canada R3C 0V8; $N/C.

The deregulation of natural gas on November 1, 1986 by the producing provinces of Alberta, Saskatchewan, and British Columbia and the government of Canada removed many of the safeguards protecting Manitoba natural gas consumers. Under this deregulated system, Americans and large industries are purchasing natural gas for substantially lower prices than Manitobans. Manitoba is implementing a fair price natural gas policy that will protect Manitobans from problems caused by deregulation and will ensure long term energy security. This document provides details of the policy that are of particular interest to Manitoba consumers.

2902 **(NEB-SS—22-1/1987-5F) Reasons for decision. TransCanada Pipelines Limited.** (Office Nationale de l'Energie, Ottawa, Ontario (Canada)). May 1987. 109p. (RH—3-86). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

On February 21, 1986, TransCanada applied to the National Energy Board for new tolls including an increase in tolls of approximately 6% effective January 1, 1987, an increase in the utility's deemed common equity ration from 30 to 35%, and a continuation of its 14.5% authorized return on equity. The Company also proposed to maintain tolls at the existing level by drawing down a portion of its deferred income taxes to offset cost increases. The Company proposed a three-part toll design consisting of a demand charge, a non-fuel related commodity charge, and a separate commodity charge for fuel and fuel-related costs that would change monthly. The Board denied TransCanada's three-part toll proposal because they believed it would be cumbersome. The Board directed TCPL to file uniform toll schedules incorporating the approved tolls, which were to be effective July 1, 1987. TransCanada requested the Board to increase the equity component in its capital structure from 30 to 35%. The Board denied this request. The Company requested the same rate of return as previously allowed for the common equity component of its capital structure. The Board reduced it from 14.5% to 13.25%. The Board rejected TCPL's proposal to draw down the balance of its accumulated deferred income taxes to offset other costs and to maintain tolls at their current level. The approved tolls provide for the recovery of the net differences between the 1986 revenue deficiency and the 1987 revenue surplus, and carrying charges, over the final six months of the test year.

2903 **(NEB-SS—22-1/1987-8E) Reasons for decision in the matter of review of natural gas surplus. Determination procedures.** (National Energy Board, Ottawa, Ontario (Canada)). Jul 1987. 61p. National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

One of the key responsibilities of the National Energy Board is to ensure that natural gas proposed to be exported is surplus to reasonably foreseeable Canadian requirements. In 1985, the Board reviewed the procedures used to determine natural gas surplus. In 1986, it announced new procedures based on the ratio of reserves to production (the R/P Ratio Procedure). The current energy policy framework is based on the premise that the marketplace should determine the supply, demand, and price for natural gas. The Board considers it appropriate that this premise also form the basis for its surplus determination procedures. However, there are a number of factors which could impede the market from adequately and fairly meeting Canadian energy requirements in the face of increased export demand. The Board decided to adopt a surplus determination procedure, referred to as the Market-Based Procedure, which does not unduly interfere with the market to serve Canadian needs adequately and fairly, but which will provide for intervention by the Board whenever it finds that additional exports might cause the market to have difficulty in meeting reasonably foreseeable Canadian requirements. The Board will act in two ways to ensure that natural gas to be licensed for export is surplus to these foreseeable requirements: one will be in the context of public hearings to consider applications for licences to export natural gas, the other will be by monitoring Canadian energy markets on an ongoing basis. These methods are discussed in detail. In the Board's view, the Market-Based Procedure is fully compatible with the market-oriented pricing regime.

2904 **(NEB-SS—870212E) Reason for decision. Westcoast Transmission Company Limited. Application dated 12 February 1987 with respect to the Export Interruptible Sales Toll.** (National Energy Board, Ottawa, Ontario (Canada)). 1987. 11p. (RH—1-87). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

Westcoast Transmission Company Limited was directed in August 1986 to file an export interruptible sales toll as part of its final tariff and to include any revenues from the application of this toll in a deferred account for final disposition at the next toll proceeding. In October 1986, Westcoast requested this toll be deleted. The Board denied the request. Presented are evidence and reasons as to why the Board found the toll necessary, the distinctions made between marketing and transportation roles, and the approved disposition of the toll revenues.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 2874, 2882, 2895, 2904

2905 **(NEB-SS—861027E) Report in the matter of a public inquiry into an accident on the pipeline system of Sun Pipe Line Company near the St. Clair River crossing in October 1986 near Sarnia, Ontario.** (National Energy Board, Ottawa, Ontario (Canada)). Mar 1987. 16p. (MICROLOG—87-03177). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

The National Energy Board conducted investigations into the circumstances of an accident on October 27, 1986 where a Sun Pipe Line Company pipeline carrying butane was accidentally damaged. The vapour was released and ignited, resulting in property damage and human injury. The escaping butane then burned on-site until the remaining line contents were displaced with water and the site secured. This report deals with the Board's findings and recommendations.

2906 **(NEB-SS—861027F) Report of a public investigation of an accident in October 1986 near Sarnia (Ontario) in the pipeline network of the Sun Pipe Line Company near the Saint Claire River crossing.** (Office National de l'Energie, Ottawa, Ontario (Canada)). Mar 1987. 13p. (MICROLOG—87-03177). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

The National Energy Board conducted investigations into the circumstances of an accident on October 27, 1986 where a Sun Pipe Line Company pipeline carrying butane was accidentally damaged. The vapour was released and ignited, resulting in property damage and human injury. The escaping butane then burned on-site until the remaining line contents were displaced with water and the site secured. This report deals with the Board's findings and recommendations.

2907 **(NEB-SS—870905E) Reasons for decision. Interprovincial Pipeline Limited. Application dated 5 September 1986 for new tolls effective 1 January 1987.** (National Energy Board, Ottawa, Ontario (Canada)). Jun 1987. 86p. (RH—4-86). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

On September 5 1986, Interprovincial Pipeline Limited applied to the Board for new tolls to be effective for the test year commencing January 1 1987. The main features of Interprovincial's application included an overall average increase in light-crude tolls of approximately 29 percent over 1986 levels, and a decrease in rate of return on equity from 15.25 to 14.75 percent, later amended to 14.5 percent and approved at 13.25 percent. The Applicant also re-

quested that the Board approve a toll design for IPL's planned propane service. The Board has not included final approved test-year revenue requirements or new tolls in these Reasons for Decision. After receipt of figures to be provided by the Applicant, the Board will verify them and issue a final order to approve the new tolls. The Board's preliminary estimate based on the numbers available on the record is that its decisions will result in an approved total revenue requirement approximately 22 percent over 1986 levels and 4 percent lower than the adjusted applied-for level. The Board found that the integrated toll design methodology approved in 1984 is no longer necessary. The Board approved IPL's proposal that the costs associated with the proposed propane project be allocated between the light-crude base and a propane surcharge, but rejected IPL's percentage surcharge proposal which would involve temporary cross-subsidization between propane shippers and other shippers on IPL's system. Financial data are included. 16 tabs.

2908 **(NEB-SS—870905F) Reasons for decision. Interprovincial Pipeline Limited. Application dated September 5, 1986 for new tolls effective January 1, 1987.** (Office National de l'Energie, Ottawa, Ontario (Canada)). Jun 1987. 92p. (RH—4-86). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

On September 5 1986, Interprovincial Pipeline Limited applied to the Board for new tolls to be effective for the test year commencing January 1 1987. The main features of Interprovincial's application included an overall average increase in light-crude tolls of approximately 29 percent over 1986 levels, and a decrease in rate of return on equity from 15.25 to 14.75 percent, later amended to 14.5 percent and approved at 13.25 percent. The Applicant also requested that the Board approve a toll design for IPL's planned propane service. The Board has not included final approved test-year revenue requirements or new tolls in these Reasons for Decision. After receipt of figures to be provided by the Applicant, the Board will verify them and issue a final order to approve the new tolls. The Board's preliminary estimate based on the numbers available on the record is that its decisions will result in an approved total revenue requirement approximately 22 percent over 1986 levels and 4 percent lower than the adjusted applied-for level. The Board found that the integrated toll design methodology approved in 1984 is no longer necessary. The Board approved IPL's proposal that the costs associated with the proposed propane project be allocated between the light-crude base and a propane surcharge, but rejected IPL's percentage surcharge proposal which would involve temporary cross-subsidization between propane shippers and other shippers on IPL's system. Financial data are included. 16 tabs.

0330 Properties

2909 **(PB—87-226833/XAB) Thermodynamic properties for natural gas binaries. Final report, January 1982-December 1986.** Hall, K.R.; Eubank, P.T.; Holste, J.C. (Texas A and M Univ., College Station (USA). Research Foundation). Apr 1987. 281p. NTIS, PC A13/MF A01.

See also Annual Report for 1983, PB—84-198506.

The objective of the project was to supply a set of data covering PVT, enthalpy and liquid/vapor equilibrium for binary systems composed of natural gas components. The authors assembled various apparatus to provide state-of-the-art measurements for these properties and have compiled a significant set of data. Much of the first three years in the project involved apparatus design and construction, while much of the final two years involved data collection.

0340 Combustion

REFER ALSO TO CITATION(S) 2884, 2885, 3575, 3664, 3987

2910 **(PB—87-232179/XAB) NOx chemistry in natural gas flames. Annual report, May 1986-May 1987.** Zabielski, M.F.; Woody, B.A. (United Technologies Research Center, East Hartford, CT (USA)). 31 May 1987. 50p. (R—957376-2). NTIS, PC A03/MF A01.

Nitric oxide (NO) formation was studied in an oxygen-enriched, near-stoichiometric (phi = 0.98), 45 torr flame. The peak temperature, measured by thermocouple corrected by sodium line-reversal, was approximately 2535K. Major, minor, and radical species were measured with molecular-beam-sampling mass spectrometry. NO was determined by quartz microprobe sampling and chemiluminescent analysis. The species concentration and temperature data were used to determine the reaction rate of $O + N_2 > NO + N$. The results of the analysis were in excellent agreement with the recommendations of Hanson and Salimian (1984). The facilities required to perform laser frequency (FM) modulated absorption spectrometry are described. Preliminary results of a spectroscopic study of nitrogen dioxide (NO_2) in the blue-green spectral region are presented. Pressure-broadening data were obtained in a room-temperature, stainless steel cell while temperature-broadening data were taken from room temperature up to 1100K in a heated, pyrex cell. A comparison of experimental data with kinetic-model predictions of the decay of NO_2 in the temperature range showed good agreement.

04 OIL SHALES AND TAR SANDS

2911 **(PRI—87/3) Bibliography of geological and engineering studies of the Cardium formation and its hydrocarbon reservoirs.** Krause, F.F.; Collins, H.N.; French, P.R.; Warner, J.D. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Apr 1987. 64p. Petroleum Recovery Institute, 3512 - 33rd. St., N.W., Calgary, Alta., Canada T2L 2A6; $10.00 CAN.

This report presents a comprehensive bibliography of geological and engineering studies of the Cardium Formation and its hydrocarbon reservoirs. Included are 384 references from 1954 to 1987 relating to a particular Cardium reservoir. In addition, there is a heavy emphasis on the Pembina reservoir. References indicate the specific reservoir the article pertains to and the availability of the article from the Petroleum Recovery Institute. This study is ongoing and will be updated and expanded. Copies of this bibliography are available on floppy disk from the Institute.

0403 Drilling, Fracturing, And Mining

2912 **(ERC—860113) Field adaptation of telemetry instrumentation in surface oilsands mines. Final report.** (Ecological and Resources Consultants Ltd., Fredericton, New Brunswick (Canada)). 13 Jan 1986. 49p. (MICROLOG—86-05137). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Two ground stability problems are of concern at Syncrude's oilsands mining operation in northern Alberta: the stability of high walls in the area of the dragline operation, and the stability of the tailings dyke. The geotehnical group at Syncrude has been searching for a reliable and continuous monitoring system which could replace or supplement their present survey system based on manually operated borehole inclinometers. The Canada Centre for Mineral and Energy Technology suggested a test of a radio telemetry monitoring system which had been developed by the Ecological and Resources Consultants Ltd. and successfully employed with electronic tiltmeters in a mining subsidence study in southern British Columbia. The telemetry system consists of a computer controlled master station which can interrogate, at any preprogrammed time intervals, up to 256 remote stations (slave units). Each slave collects and transmits survey data from four monitoring sensors. The main question in adapting the telemetry system to Syncrude's monitoring requirements was whether the system could transmit the data over distances up to 6 km with partially obstructed lines of sight in the environment of Syncrude's operation with possible interference from multiple high power cables, intensive radio communications at various frequency bands, etc. In August 1985, the telemetry system, with five slave stations, was installed and tested on both sites: a dragline bench and the tailings dyke. 17 figs., 2 tabs.

2913 **(ERC—870315) Upgrading and maintenance of CANMET's radio telemetry system. Final report.** (Ecological and Resources Consultants Ltd., Fredericton, New Brunswick (Canada)). 15 Mar 1987. 39p. (MICROLOG—87-04018). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Between August 1985 and February 1986, CANMET's tiltmeter/telemetry system with five slave stations underwent field tests at Syncrude's oil sands mining operation. The purpose of the tests was to investigate a possible adaptation of the system to monitoring the stability of high walls in the dragline operation and of the the tailings dyke, under severe climatic conditions. This report deals with some improvements required to better adapt the system to specific needs.

2914 **(ERCB/C—870909) PanCanadian Petroleum Limited. Application for a well licence. Medicine Hat Field.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 9 Sep 1987. 7p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

PanCanadian Petroleum Limited applied for a license to drill a well for the purpose of obtaining oil production from the Glauconitic Sand. An objection was received by the Energy Resources Conservation Board. A public hearing was held in July 1987 when the issues considered were the need for the well, its impact on the land surface, and its impact on future development plans for the land surface. The Board decided that the well can proceed without significant impacts and will issue the licence. Views of the Board, the intervenors, and the applicant are presented.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 2839, 2840, 2928

2915 **(BCU/CE—8602) Gasification of oil sands coke.** Watkinson, A.P.; Cheng, G.; Quan, R. (British Columbia Univ., Vancouver (Canada). Dept. of Chemical Engineering). Feb 1986. 69p. (MICROLOG—86-03138). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Coke derived from two Alberta oil sands operations has been gasified in a steam and oxygen blast using an atmospheric pressure gasifier operated as both a fluidized and a spouted bed. Suncor coke crushed to an average size of 1.5 mm was treated in the spouted bed, whereas the Syncrude coke was gasified in fluidized beds of coarse sand, coke, or dolomite. It was demonstrated that a strong gas of 8.4 MJ/m/sup 3/ heating value could be produced. H/sub 2/ and CO levels were about 39% and 20-30% respectively in the dry gas, with substantial levels of CO/sub 2/. Carbon conversions varied between 20 and 94% depending on conditions. The effects of oxygen/coke ratio, rate of recycle of cyclone char, temperature and feed rate on gas heating value, carbon conversion, and efficiency were established. Results with Syncrude coke were somewhat poorer than with Suncor coke, particularly with respect to carbon conversion. Potassium carbonate added in dry form was an effective catalyst, raising carbon conversion and steam decomposition while permitting operation at about 100/sup 0/C lower than otherwise was possible. Dolomite beds effectively trapped sulphur emissions from the 6-7% S-containing coke, yielding gases with sulphur levels <0.1%. 19 figs., 12 tabs.

2916 **(CU/C—860901) Preparation of oil sand coke-water slurry for entrained bed gasifier using ultrasonic treatment. Executive summary.** Kruus, P.; Patraboy, T.J. (Carleton Univ., Ottawa, Ontario (Canada). Dept. of Chemistry). 1 Sep 1986. 13p. (MICROLOG—87-04006). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The upgrading of Athabasca oils sands bitumen involves a coking process. Currently used are a delayed coking technique and a fluid coking process. The energy content of this coke might be recovered through gasification rather than direct combustion. This would reduce the amount of off-site energy that is consumed by the upgrading plants. The product gas might be used as feedstock for other processes such as liquefaction. High gasification conversions can be achieved in an entrained bed reactor. A slurry feeding system would increase the flexibility of the reactor type. Additives such as surfactants and stabilizers can control stability and pumpability of the feed slurry. An evaluation of the efficacy of several additives and some methods for aqueous coke slurry preparation was carried out. An assessment of the consistency of several oils sands coke slurries was achieved using a modified rod penetration test. Results showed that most commercial additives improved the stability of slurries significantly. It was determined that intense ultrasound was more effective as a mixing method than mechanical mixing.

2917 **(DOE/FE/60177—2439) Production of spent shales by simulation of surface oil shale retorting processes.** Merriam, N.W.; Cha, Chang Yul; Sullivan, S. (Western Research Inst., Laramie, WY (USA)). Aug 1987. Contract FC21-83FE60177. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002173/JAW.

This report documents sources of the raw shale and the processing conditions used to produce spent shale for solid waste studies. Fourteen bathes of spent shale were produced for these studies, seven from 1986 eastern reference oil shale and seven from 1986 western reference oil shale. Spent shales representing those produced in surface processes characterized by low heating rates, large particle sizes, and long residence times were produced in the fixed-bed Paraho batch pilot plant. Spent shales representing those produced with high heating rates, small particles, and short residence times were produced in an inclined fluid bed reactor built by Western Research Institute. The processing conditions were varied to include both direct and indirect retorting. The gas composition, heating rate, maximum temperature, and residence time typical of known oil shale surface retorting processes were used to produce these spent shales. Also, some shale was exposed to temperatures above 1600°F (870°C) to study changes in the composition of certain minerals and to create a combination of high temperature and oxidizing atmosphere to produce spent shale with very low residual organic carbon content. Conclusions are as follows: (1) The residual organic carbon and sulfur content of spent shales processed in air in an inclined fluid bed are lower than the residual organic carbon and sulfur content of spent shales processed in air in a fixed bed. (2) The residual organic carbon content of shales from the direct retorting of eastern shale is higher than the residual organic carbon content of spent shales from the direct retorting of western shale. (3) The residual sulfur content of retorted eastern shale is higher than the residual sulfur content of retorted western shale. (4) The highest sulfur, organic carbon, and nitrogen content is produced in the spent shale by retorting with recycle gas. 9 refs., 18 figs., 6 tabs.

2918 **(GULF/C—850814) Treatment of synthetic crudes with metal chlorides and metal carbonyls. Final report.** Dymock, K.R.; Giampuzzi, M.J. (Gulf Oil Canada Ltd., Sheridan Park, Ontario. Research and Development Dept.). 14 Aug 1985. 55p. (MICROLOG—86-05134). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The majority of Canada's fossil fuel resources are tar sands, heavy oil and coal. These materials, when converted to synthetic crudes, produce liquids which are rich in nitrogen and sulfur species as well as containing considerable amounts of high boiling heavy ends. This implies that the removal of nitrogen and sulfur compounds from heavier fractions is of primary importance since their effective elimination would reduce or eliminate the need to remove their cracked products from lower boiling transportation fuels, such as gasoline and middle distillate. Although a variety of commercially proven processes is available for removing sulfur compounds, the options for denitrogenation are more limited. Liquid extraction of the oil using mineral acids poses serious problems due to emulsions. Denitrogenation by hydrotreating requires more severe conditions than hydrodesulphurization. Precipitation with metals has been used commercially in the petroleum industry to desulphurize both gasolines and middle distillates manufactured

from sour crudes. Nitrogen compounds can be selectively removed from aromatic systems by reaction with solid Lewis acids. This project explores this approach further by assessing the ability of Lewis acids and transition metal complexes to act as extractants for sulfur and nitrogen species. Metal carbonyls and hydridocarbonyls, particularly those of iron, react vigorously with both nitrogen and sulfur compounds and are also used as homogenous catalysts in a number of industrial processes. The utility of these catalysts is based on the complexes they form with hydrogen, carbon monoxide and a ligand which allow high energy conversions to occur readily and with specificity. The complexation of inorganic molecules with various problematic components suggests a novel approach to eliminating these species from synthetic crude gas oils.

2919 **(PCPP/RD—86) Hydrogenation and its effects on fluid catalytic cracking unit feedstocks. Final report.** Curts, L.E.; Dymock, K.R. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). [1986]. 91p. (MICROLOG—86-05093). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objective of this project was to encourage the utilization of Canadian heavy oil and tar sand resources by means of developing improved methods or more economical schemes of refining synthetic crudes into liquid fuels. An experimental program was undertaken to quantitate the effects of hydrogenation on the cracking yields of conventional fluid catalytic cracking unit feeds. Results show increased yields of gasoline can be obtained from catalytic cracking by hydrogenating the feedstock. Five gas oils from conventional and synthetic crude oils were hydrogenated over sulphided catalysts. This produced a range of hydrotreated products which were catalytically cracked in a microactivity test apparatus to estimate fluid catalytic cracking unit yields. Coker and conventional gas oils gave significant increases in gasoline yields after consuming 50-700 scf/bbl hydrogen. Synthetic gas oils from Syncrude and Suncor were much more difficult to hydrogenate, consumed less hydrogen and produced significantly less additional gasoline when cracked.

2920 **(PCPP/RD—86) Impact of nitrogen compounds on the processing of synthetic gas oil. Final report.** Chmielowiec, J. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). [1986]. 101p. (MICROLOG—86-06107). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The effect of nitrogen components on the hydrocracking of Syncrude gas oil was studied. The gas oil was denitrogenated by solvent extraction with dimethyl sulfoxide based media. Model feeds, prepared by doping the denitrogenated oil with model nitrogen compounds, were used to characterize activity of Ni/W catalyst. The hydrocracking experiments were performed using bench-scale microreactors, while product evaluation tests were carried out using pilot-plant scale reactors. Conversion of syncrude gas oil was found to be dependent on the total nitrogen content. Most of the types of the nitrogen functional group influenced product characteristics to a small extent. An enhancement of hydrocracking yields was observed for the denitrogenated gas oil feedstocks. Middle distillates of higher cetane number and low aromatic naphthas were produced from these feeds. Evidence on the inhibition of cracking- and aromatic ring saturation-reactions by nitrogen components is discussed. 7 figs., 17 tabs.

2921 **(RPC—841214) Demonstration of an integrated oil shale retort system. Final report.** Salib, P.; Barua, S.; Abbott, D. (New Brunswick Research and Productivity Council, Fredericton (Canada)). 14 Dec 1984. 157p. (MICROLOG—85-3429). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report demonstrates an integrated retort system. The objectives of the work were to investigate three retorting techniques, namely, indirect retorting, direct retorting and an integrated system consisting of a retort and a fluidized bed combustor using Albert County oil shales and Minto coal. The experimental program undertaken was carried out in three main phases: direct and indirect retorting experiments, co-combustion of coal/spent shale in a fluidized bed combustor and integrated system experiments. Important findings include: high oil recoveries, up to 90% for indirect retorting and 81% for direct retorting; the quality of New Brunswick shale oils has been shown to be better than Colorado shale oils; and the spent shale was shown to be an effective sulphur capture medium. 19 figs., 25 tabs.

2922 **(RPC—860724) Modification of integrated oil shale retort system. 50/50 cost shared energy conversion program.** Salib, P.; Barua, S.; Robson, R.; Ritchie, C. (New Brunswick Research and Productivity Council, Fredericton (Canada)). 24 Jul 1986. 72p. (MICROLOG—86-05138). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The combustor retort system was redesigned and rebuilt. The pilot plant consists of a circulating fluidized bed combustor of 13 cm internal diameter, primary cyclone and standpipe, J-valve, heating and cooling system and baghouse. The retort has an inside diameter of 25.4 cm and is 2.9 m high with solids feeding and withdrawal system, equipment for product oil recovery, a gas recycling network and gas sampling system. A heat exchanger was built specifically for using the combustor heat for the retorting. Retorting with the indirect method by heating of the circulating gas gave good oil yields. There were no difficulties with combustor performance when fired only on coal. Firing the circulating fluidized bed with spent shale of large size with the coal resulted in clinkering. Hence the fully integrated system with the combustor burning coal and spent shale to produce heat for the retorting of raw shale and the collection of a liquid petroleum product was limited. 4 figs., 4 tabs.

2923 **(SNC/TD—8410) Treatment of oil/water/mineral emulsions for bitumen and heavy oil. Final report.** (SNC Group, Montreal, Quebec (Canada). Technical Development Dept.). Oct 1984. 209p. (MICROLOG—85-2544). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study assesses the commercial and emerging methods for separation of oil/water/minerals from an emulsion. A literature search was carried out and contacts were made with oil producers, chemical suppliers and equipment suppliers. Commercial methods used for treating produced fluids in the oil fields have been identified and the flow diagrams prepared. These systems were classified in four groups, in order of difficulty occurring in the treatment of emulsions. Systems were then compared and advantages and disadvantages discussed. Based on the analysis of the results of the survey, six systems were developed to meet the overall needs of the industry and a simplified flow sheet was prepared for each of these systems. Capital, operating and maintenance costs of a typical commercial system were developed. Economic assessment of the commercial systems was made, using the established cost data. 43 figs., 14 tabs.

2924 **(ST—85) Treatment of pitch with methanol. Final report.** (Sandwell Technologies (Canada)). 1985. 99p. (MICROLOG—86-02907). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Pitch with a boiling point above 525/sup 0/C is a heavy residue from refining/upgrading processes. Because of its high content of sulfur and metals, pitch cannot meet the Canadian combustion specifications, and is not suitable as a starting material for making electrode coke. As part of the effort to establish new technologies for conversion of the pitch into marketable liquids, CANMET initiated in 1984 a research program for use of methanol for upgrading of the 525/sup 0/C pitch into distillable products. The testing program undertaken by Sandtech covered the selection of suitable catalysts and of reaction parameters, as well as the investigation of the effect of these parameters over the pitch conversion. This

report describes the equipment used, the procedures developed for the testing, the main experimental results, some preliminary economic considerations, and the conclusions drawn at the completion of research. The tests were compared on the basis of the pitch conversion, the distillate yield, and the coke formation. The economic model for the calculation of the internal rate of return of investment had been developed in-house by Sandtech for its own use. This report includes the results of these calculations as well as the results of a preliminary sensitivity analysis. 25 figs., 21 tabs.

2925 **(TU/CEAC—8609) Numerical simulation of steam injection in bitumen and heavy oil reservoirs. Phase 1. Part 2.** DeBuda, P.G.; Cormack, D.E. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). Sep 1986. 76p. (MICROLOG—86-06701). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The one-dimensional steam injection simulator, developed in part 1 of this work to track the movement of the steam front as it progresses through a one dimensional core, is extended to two dimensions. The technique for handling the dynamic grid, and the block-balance method used to develop the finite-difference approximation to the governing equations, boundry conditions, and matching conditions (at the steam front) are described in considerable detail. Some preliminary numerical results are presented for the two-dimensional simulation. An extensive survey of the open literature describing the physical properties of the Cold Lake heavy oil deposit, required for the numerical simulation of the oil recovery process, was also carried out. Tables of reported properties are provided and values considered representative are summarized. 14 figs., 5 tabs.

2926 **(WOU/ES—8311) Application of photometric techniques to the study of three-phase fluidized bed reactors used in the hydrocracking of heavy oils. Final report.** de Lasa, H.; Bergougnou, M.A.; Lee, S.L.P. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Nov 1983. 151p. (MICROLOG—85-5918). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A photometric technique was developed at the University of Western Ontario to study bubble behaviour in three-phase fluidized beds constituted by fine particles. A novel custom made U-shaped single core silica fiber to be used as a bubble sensor was fully demonstrated employing a bidimensional column and a cylindrical column. A helium-neon laser beam was introduced at one end of the U probe and the variation of the light intensity, occurring when a gas bubble contacted the sensor, was detected at the other end of the fiber. Several of these probes and an advanced data acquisition system were employed during the systematic runs to measure bubble velocities, bubble frequency, and axial bubble cords. Simultaneous recording of the pressure profiles in the bed allowed the estimation of the hold-ups of the different phases (gas, liquid, and solid). This fluid dynamic data was obtained for a three-phase fluidized bed constituted by water, air, and 335μm glass beads. 57 figs., 5 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 2864, 2917, 2920, 2925

2927 **(CU/C—860901) Preparation of oil sand coke-water slurry for entrained bed gasifier using ultrasonic treatment. Final report.** Kruus, P.; Patraboy, T.J. (Carleton Univ., Ottawa, Ontario (Canada). Dept. of Chemistry). 1 Sep 1986. 41p. (MICROLOG—87-04006). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

An assessment was made of the effect of a combination of surfactant PLURONIC F108 with each of three stabilizers (Wyoming bentonite, xanthan gum, and guar gum) on the storage properties of aqueous slurries containing 60 wt% oil sand coke. This was accomplished using a modified rod penetration test. Such tests revealed the existence of an optimum concentration of each additive. Slurries that were prepared with the optimum concentration of additives showed the best combination of static stability and fluidity. Three particle size distributions of Syncrude coke were examined to determine the effect of particle size on slurry stability. It was found that the concentration of stabilizer that was required to yield a fluid slurry increased as the relative fraction of coarse particles increased. 4 figs., 4 tabs.

2928 **(RPC—84/103) Effect of temperature and hydrogen pressure on liquid yields from selected oil shales. Final report.** Synnott, J.; Mersereau, M. (New Brunswick Research and Productivity Council, Fredericton (Canada)). 22 May 1985. 100p. (MICROLOG—85-5931). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A total of five oil shale samples from Eastern Canada were evaluated using Fischer Assay Retort and hydrogen retort methods. For all shales, the presence of hydrogen during retorting resulted in increased yields compared to Fischer Assay yields. The five oil shales were evaluated at selected hydrogen pressures, retorting temperatures, and heating rates. Generally increasing hydrogen pressures during retorting had little effect on oil yields, while increasing retorting temperatures increased oil yields significantly. Higher gas yields at increased retorting temperatures were partially attributed to the generation of CO/sub 2/ from the dissociation of mineral carbon. Nitrogen content in oil products was found to increase in the presence of hydrogen. This was attributed to the stabilization of reactive intermediates by hydrogen. Sulfur content in oil products was found to decrease in the presence of hydrogen. This decrease was believed to be the result of increased sulfur in the gaseous products. 30 figs., 20 tabs.

2929 **(WU/WCPD—8501) Treatment of bitumen/oil emulsions and effluent waters.** Rhodes, E. (Waterloo Univ., Ontario (Canada). Waterloo Centre for Process Development). Jan 1985. 375p. (MICROLOG—85-5920). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A new flow loop in which oil/water emulsions can be recycled has been built at the University of Waterloo. The loop has five pipes of different diameters and a separate pipeline designed to receive specialized flow measuring instrumentation. After a comprehensive literature review on the subjects of flow measurement and transport characteristics of emulsions, experimental studies have been undertaken in the areas of rheology, flow metering, and pipeline flow of emulsions. Both artificial (mineral oil based) and real (heavy oil based) emulsions have been studied. 35 figs.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 2842, 2916, 2927

2930 **(PCPP/RD—8603) The effect of nitrogenous concentrate from synthetic crudes on asphalt blends.** Kamel, N.I. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). Mar 1986. 38p. (MICROLOG—86-05139). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objectives of this project were to carry out a literature search on use of nitrogen compounds in paving asphalts, to extract large samples of nitrogen concentrates from 2 synthetic crudes, namely raw Syncrude and Suncor Coker gas oils, to prepare test samples of 85-100 pen paving asphalts containing various levels of nitrogen extract and to test and analyse all base and test samples to determine the effects on asphalt physical properties and characteristics due to blending the nitrogen compounds. The literature search indicted that no data are available identifying the effects on physical properties of asphalt blends containing nitrogen compounds from synthetic crudes. However, such nitrogen-rich compounds extracted from shale oil were investigated as additivies in asphalt-ag-

gregate mixtures and showed potential for use as antistripping agents and as rejuvenators to restore desired viscoelastic properties of aged asphalts. It is concluded that the inclusion of nitrogen concentrates in the asphalt results in reducing the qualities of the paving asphalt. Both nitrogen extracts examined, however, can feasibly be utilized as blending components in paving asphalts if used in limited small quantities. 8 figs., 9 tabs.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 2854, 2917

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 2912

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 3729

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 2969, 3162

2931 **(FRNC-TH—2929) Uranium deposits of Gabon and Oklo reactors. Metallogenic model for rich deposits of the lower proterozoic.** Gauthier-Lafaye, F. (Strasbourg-1 Univ., 67 (France)). May 1986. 245p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750463/JAW.

The geology of the Franceville basin (Gabon) is examined: stratigraphy, tectonics and geodynamics. The mobile zone of the Ogooue is specially studied: lithology, metamorphism and tectonics, isotopic geochronologic data are given. The different uranium deposits are described. A whole chapter is devoted to the study of Oklo natural nuclear reactor. A metallogenic model is proposed evidencing conditions required for deposit genesis. Tectonics, microstructures sedimentology, organic matter, diagenesis and uraniferous mineralizations are examined.

0504 Feed Processing

2932 (CONF-8704115—Summ., pp 7-24) **Risk analysis as applied to mill tailings piles and hazardous wastes.** Parker, F.L. (Vanderbilt Univ., Nashville, TN). 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Some social and scientific aspects of risk assessment are explored by considering applications to three problems. Case studies of risk analysis of uranium tailings, thorium tailings and chemical wastes are presented. Reliability of knowledge and data bases and effects of public perception of risk and the assessment process are considered.

2933 (CONF-8704115—Summ., pp 25-28) **Hazardous waste handling and disposal workshop.** Turi, G.P.; Falconer, K.L. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

On April 29, 1987 an all day workshop was held on Hazardous and Mixed Waste Handling and Disposal. The workshop was part of the annual Remedial Action Programs Meeting held in Grand Junction, Colorado. It was co-facilitated by Gale P. Turi of the DOE and Kathleen L. Falconer of UNC Geotech. The workshop was divided into a morning and an afternoon session. The morning session provided an overview of the requirements pertinent to the handling and disposal of hazardous and mixed waste. In the afternoon session the DOE's Headquarters' perspective of the applicable requirements was given along with the position of each of the Remedial Action Programs: the Uranium Mill Tailings Remedial Action Program (UMTRAP), the Formally Utilized Site Remedial Action Program (FUSRAP), and the Surplus Facilities Management Program (SFMP).

2934 (CONF-8704115—Summ., pp 29-33) **Performance measurement systems workshop.** Dziedzic, K.T.; Fulton, J. (DOE-Oak Ridge Operations Office, TN). 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The performance Measurement Systems Workshop discussed the application of performance measurement systems for planning and controlling remedial action projects. The workshop consisted of six major presentations which prompted open forum discussions on shared experiences and lessons learned. The topics included were: 1. life cycle planning and reporting requirements and fiscal year planning and reporting requirements; 2. remedial action cost estimating; 3. program integration; 4. remedial action project computer hardware and software needs and experiences; 5. cost schedule control systems validation process; and 6. DOE-HQ perspectives of performance measurements. Each of the workshop presentations and related discussions are summarized to document major observations and lessons learned.

2935 (CONF-8704115—Summ., pp 35-38) **Verification measurements workshop.** Wallo, A.; Tucker, M.K.; Duray, J.R. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The Verification Measurements Workshop concentrated on three principal topics: measurements and their use in the verification/certification process, the application of supplemental standards, and independent verification. These topics are covered in four major sections and concluded with the fifth section on recommendations and concerns.

2936 (CONF-8704115—Summ., pp 39-42) **Public relations programs workshop Tuesday, April 28, 1987.** Mygatt, P.; Scotti, K. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Discussions began with consideration of the impact various guidelines and regulations have on the development of a public/community relations program. The need to examine both federal and state requirements before beginning a program was stressed. The elements of a viable outreach program were then outlined and public relation tools were discussed. Several site-specific case studies were considered and sessions were devoted to owner relations and crisis management.

2937 (CONF-8704115—Summ., pp 45-58) **Case study: UMTRAP mill sites Lakeview tailings site.** Sena, R. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Several aspects of the disposal of mill tailings from the Lakeview Mill site in Oregon are presented in a series of view graphs. Topics addressed include EPA standards, local geology and hydrology, natural resources and recent impetus for cleaning up the site. The layout and design of the Collins ranch site is shown. Locations of other sites are also presented.

2938 (CONF-8704115—Summ., pp 59-79) **Case study: UMTRAP vicinity properties.** Garcia, J.; Madson, M. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Copies of photographs are presented for the purpose of reviewing the vicinity property case study as presented at the Annual Remedial Action Program Meeting held in Grand Junction, Colorado, on April 29, 1987. The slides were presented as a means of

displaying the remedial actions performed on one vicinity property from the start of remedial actions to completion. The photo copies display remedial action states associated with a Strabane, Pennsylvania, vicinity property located near the Canonsburg Uranium Mill Tailings Remedial Action (UMTRA) site. Two hundred and seventy-six cubic yards of residual radioactive materials were excavated, removed, and encapsulated within the Canonsburg disposal cell. Remedial action included exterior excavation covering approximately 70% of the outdoor surface area and a small amount of interior excavation with the basement. This vicinity property was certified as having EPA standards on April 17, 1987.

2939 (CONF-8704115—Summ., pp 81-92) **Remedial action graphics management system.** Madson, M.E. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The objective of the Graphics Management System is to provide a visual display of the Grand Junction vicinities properties status as a cost effective management tool. Capabilities of the system are listed and a series of sample displays are presented.

2940 (CONF-8704115—Summ., pp 93-104) **Case study SFMP Weldon Spring start-up.** Newtown, G.A.; Hammond, J. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Descriptions of the history of the Weldon Spring site, the types of contaminants existing there and the establishment of the DOE remedial action program are given. Following this the NEPA process is outlined and the Notice of Intent and the Environmental Impact Statement are discussed. The decision making process for the site is considered.

2941 (CONF-8704115—Summ., pp 107-110) **Weldon Spring site remedial action project startup project management contractor's point of view.** Hammond, J.D. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Project management for the site is illustrated in a series of view graphs. Contracting, project control and communications are considered. Chronologies of the project and the NEPA process are shown and baseline data for the project are summarized.

2942 (CONF-8704115—Summ., pp 169-189) **Case study: West Valley - a status update.** Maestas, E. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The West Valley Demonstration Project, directed by the United State Department of Energy, is at the site of the only commercial nuclear fuel reprocessing facility to have operated in the US. Operation of the plant ceased in the early 1970s. It was determined in 1980 that the facility provided a unique opportunity for demonstrating established high-level nuclear waste management technology. Engineers, scientists, and innovative thinkers here are showing the world that nuclear waste can be safely cleaned up. The heart of the high-level waste solidification system has been designed, built, and installed. Engineering tests are currently underway. Additional processing and support systems will be added this year, followed by modifications and adaptations for remote operation. The site is receiving international attention for its progress in the decontamination and decommissioning of this former nuclear fuel reprocessing facility. Miles of contaminated piping and dozens of large radioactive vessels have been removed. New handling, packaging, and disposal techniques have been developed to manage the low-level waste generated during cleanup. Additionally, engineers have directed the safe return of over 600 spent nuclear fuel assemblies from storage at West Valley back to their utility owners.

2943 (CONF-8704115—Summ., pp 151-167) **Case study: West Valley - a status update.** Kannard, J.R. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

FUSRAP in New Jersey consists of five sites, representing 17% of all sites in the FUSRAP program. Three of these; one in Middlesex, one in Wayne, and one in Maywood are discussed. Each of these is being used as an interim storage site for contaminated material from vicinity properties. They also represent three distinct stages of completion of interim remedial action also having been accomplished. Contrasts range from drastically different attitudes in the public and local government sector to significant differences in quantities of contaminated materials, and the mechanisms by which they migrated to vicinity properties. And, in each case, the main concern on the part of the public is lack of a location for permanent disposal. The history, objectives, and accomplishments for each site will be discussed; and, in keeping with the overall theme of the conference, those activities which were undertaken during FY 1986 to enhance productivity enhancement will be described and several areas demonstrating improved cost effectiveness will be discussed.

2944 (CONF-8704115—Summ., pp 191-192) **Report from the working group on Hazardous and Mixed Waste Management.** 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The working group on Hazardous and Mixed Waste Management was formed to provide for increased transfer of experience among participants in remedial action programs. The group focuses on reviews of requirements, standards, disposal options, problems, liability insurance issues and program management. Discussions held at the first two meetings are briefly outlined.

2945 (CONF-8704115—Summ., pp 195-201) **Report from the disposal cell design committee.** D'Antonio, J. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

Several aspects of disposal cell design are presented in a series of view graphs. Topics covered include: program objectives, enabling authority and requirements, environmental requirements, institutional requirements, public participation and project management. Design development issues are outlined. These include: pile configuration, site selection and characterization and technology development.

2946 (CONF-8704115—Summ., pp 203-213) **Ad hoc committee report vicinity property remedial action standards, verification, and certification committee.** Sena, R.; Tucker, M.; Pepin, J.; Moore, C.; Borden, B.; Murri, D.; Little, C.; Tappen, T.; Young, C.; Brazley, T.; Wallo, A. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

This committee is charged with reviewing procedures for conducting vicinity property remedial action and certification, verification and documentation processes and identifying areas of commonalty and differences. Topics considered are presented in a series of view graphs. They include summaries of directives, regulations and standards related to verification, certification, radiation assessment, radiological engineering, land surveying and mapping, performance contracting and excavation monitoring and sampling.

2947 (CONF-8704115—Summ., pp 215-221) **Ad hoc committee report disposal site long-term surveillance and maintenance committee.** Matthews, M.; Coleman, J.; Caldwell, J.; Lechel, D.; Knight, B.; Valenti, P.; Murphie, W.; Gatrell, J. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

This group reviews surveillance and maintenance requirements, standards, practices and costs in order to identify commonalties and differences and explore adoption of common approaches. Topics considered are presented in a series of view graphs. They include applicable regulations and legal basis for programs, comparisons of program status and procedures and costs, and a summary of agreements and proposed future actions.

2948 (CONF-8704115—Summ., pp 223-231) **Productivity quality improvement at UNC Geotech.** Jenkins, W.A. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The program to improve productivity is presented in a series of view graphs. Key elements of the program are: CEO leadership and commitment; measurable improvements; specific annual goals; system for sharing benefits of improvements; practical training for employees; and intent to institutionalize.

2949 (INIS-mf—10951) **Treatment of Abankor uranium ore by the Eluex process. Simulation of the extraction cristallisation using ASPON plus simulator.** Mehablia, M.A. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Mar 1987. 151p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700034/JAW.

The Eluex process is a possible way of treating the Abankor uranium ore; this work represents a preliminary approach in the development of a process for this ore. However, a cost study would be necessary to enable the appropriate choice of a most adequate flowsheet. The parameters concerning comminution, extraction-purification and concentration for the Eluex process have been obtained. A leaching efficiency of up to 95% was reached with a mean consumption in acid (120 kg of sulfuric acid per metric ton of ore). The concentration-purification of the leach solution was carried out in two successive stages: a strong base ion exchange was used to yield an eluate (5 g U/1) that was then contacted, in a second step with a solvant (D2EHPA + Kerosene) to give an organic solution of 26g U/1. Ammonium uranyl tricarbonate (AUC) was obtained by combining the uranium stripping and cristallization processes in a single operation. A simulation of this last stage was carried out using Aspon plus software.

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 3120

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 3750, 3804

2950 (INIS-BR—874, pp 237) **Ceramic sphere production by a gel casting.** Santos, A.; Assis, G. de; Ferreira, R.A.N.; Ferraz, W.B.; Lopes, J.A.M.; Prado, M.A.S.; Miranda, O.; Drumond, F.J. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The technology of (Th,U)O/sub 2/ microspheres production by gel casting and subsequent thermal treatment has been transferred from NUKEM CmbH assisted by Kraftwerk Union A.G., both West Germany, to NUCLEBRAS, where it was jointly adapted to produce microspheres suitable for pressing. As a result, there are now available various possibilities to produce ceramic spheres with different characteristics that can be used in different applications. Examples of these characteristics are the range of gel sphere diameters (200 to 5000μm) and the value of the specific surface (about 50 m/sup 2//g for calcined (Th,U)O/sub 2/ and potentially higher than 200 m/sup 2//g for other ceramic materials).

2951 (INIS-BR—874, pp 82) **Simulation of the measure of the microparticle size distribution in two dimensions.** Lameiras, F.S.; Silva Neto, P.P. da. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte, Brazil; Companhia Vale do Rio Doce, Belo Horizonte, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

For the nuclear ceramic industry, the determination of the porous size distribution is very important to predict the dimensional thermal stability of uranium dioxide sintered pellets. The determination of the grain size distribution is still very important to predict the operation behavior of these pellets, as well as to control the fabrication process. The Saltykov method is commonly used to determine the microparticles size distribution. A simulation for two-dimensions, using this method and the size distribution of cords to calculate the area distribution.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 3450, 3803, 3811, 4420

2952 (CEA-CONF—8990) **Extraction of 4f and 5f elements with substituted malonamides.** Cuillerdier, C.; Hubert, H.; Hoel, P.; Chachaty, C.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Mar 1987. 7p. (CONF-8703187—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750252/JAW.

From 17. meeting on actinides; Lausanne, Switzerland (26 Mar 1987).

Diamides of carboxylic acids can be used as extractants for actinides (including trivalent ions) from radioactive wastes solutions in nitric acid medium. They could be an alternative to the mixture (carbomoylphosphonate-TBP) used in the TRUEX process. These solvents are interesting economicaly because they are easy to prepare and to purify. They are completely incinerable and don't create new wastes. Good results have been obtained with tetraalkylmalonamides. This paper deals with pentaalkyles propane diamides with generic formula: (RR'NCO)/sub 2/CHR" where R and R' are dissymetric (for instance R = CH/sub 3/ and R' = C/sub 4/H/sub 9/). Extraction coefficients of Am/sup 3+/ are given to show the influence of R". Increasing the length of R" enhances the distribution coefficients. Good results are obtained with long oxyalkyl radicals, but there is an optimum in the size of the oxyalkyl radical, ramification has a weak influence. The substituent has an influence upon the surrounding of the metal extracted. In the case of simple malonamide four molecules of ligand participate in the complex formation and in the case of substituted amide only two. The better extraction by pentaalkylpropane diamide can be interpreted on the basis of higher molecular flexibility as shown by NMR data. Extraction of uranium, plutonium and fission products have also been done showing the pratical possibilities of these solvents.

2953 (CEA-CONF—8991) **Di-n-butyl phosphoric complexes of tetravalent actinides.** Livet, J.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Mar 1987. 11p. (CONF-8703187—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750253/JAW.

From 17. meeting on actinides; Lausanne, Switzerland (26 Mar 1987).

Di-n-butylphosphoric acid (HDBP) is the main tri-n-butylphosphate degradation product formed during the irradiated fuel reprocessing by the Purex process. This strong acid forms insoluble metallic compounds with the 5f elements tetravalent ions. This paper deals with the identification of thorium-DBP precipitates by X ray powder diffraction and chemical analysis. The crystalline structure of Th (NO/sub 3/)/sub 2/(DBP)/sub 2/.H/sub 2/O and solubility in chloride media are reported.

2954 **(FRNC-TH—2813) Study and development of a mixer-settler for plutonium separation by an electroprocess in the nuclear fuel reprocessing.** Schmieder, H. (Institut National Polytechnique, 38 - Grenoble (France)). Sep 1984. 114p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750464/JAW.

Redox potential of plutonium, uranium, nitric acid and hydrazine are examined. Electrochemical reduction of plutonium and uranium and materials corrosion are studied experimentally for the construction of a compact apparatus for uranium/plutonium separation. A first prototype is in function at the reprocessing plant of Karlsruhe since 1979. Reduction ratio, which is dependent of cathodic surface and uranium content, is fixed by 3 reactions: direct electrolytic reduction of Pu(IV), indirect reduction of Pu(IV) by U(IV) and reduction of Pu(IV) by hydrazine. A mathematical model is developed.

2955 **(INIS-GB—99) Sellafield Site (including Drigg) emergency scheme manual.** (British Nuclear Fuels Ltd., Sellafield). Feb 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750120/JAW.

This Scheme defines the organisation and procedures available should there be an accident at the Sellafield Site which results in, or may result in, the release of radioactive material, or the generation of a high radiation field, which might present a hazard to employees and/or the general public. Several categories of emergencies on the Sellafield Site are mentioned; a building emergency which is confined to one building, a Site emergency standby when the effects of a building emergency go outside that building, a Site emergency alert (District Emergency Standby) when a release of activity affects Site operations and could have serious Site effects and a District Emergency Alert when a radioactivity release may interfere with the normal activity of the General Public. A Drigg Emergency Standby situation would operate similarly at the Drigg Site. The detailed arrangements and responsibilities of appointed personnel are set out in this manual.

2956 (PTB-SE—14, pp 113-127) **Fast analysis of Np and Pu in the uranium end product of the reprocessing stage.** Ganz, M.; Schmidt, L.; Feige, G.; Molzahn, D.; Jungclas, H.; Brandt, R. (Marburg Univ., Germany, F.R. Fachgebiet Kernchemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

A method was to be developed for routine determination of Np-237 and Pu-238-242, especially a fast method for isotopic analysis of the plutonium isotopes. From samples of uranium end product solutions of the reprocessing step, the Np and Pu activities have been chemically separated and reprocessed. For this purpose, various chemical separation techniques have been combined for suitable series of separation steps, suitability being proven by alpha-spectroscopy. Isotopic analysis has been made with a time-of-flight mass spectrometer as alpha-spectrometry is not applicable to the three isotopes Pu-239, 240, 241. Specimen preparation has been done by electrodeposition of the transuranium elements from weakly acid solution onto thin platinum foils. Np and Pu isotopes have been detected by the time-of-flight mass spectrometer which will be modified and improved for this type of analysis in order to achieve still better results.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 3111, 3178, 4006

2957 **(CEA-CONF—8931) Radioactive materials transport regulations.** Devillers, C.; Berson, E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1986. 13p. (In French). (CONF-8610337—1; CEA-DAS—296). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750081/JAW.

From SFRP meeting on mastering of a transport system for dangerous materials; Paris, France (7 Oct 1986).

Transport regulations for dangerous materials and especially radioactive materials are presented and national and international regulations concerning the different transport means are recalled. Safety principles are presented for packaging conception and dispositions for handling, loading and transport are described. Information likely to guide intervention in case of accident and usefulness of reporting incidents or accidents are presented. Practical application of regulations and different types of authorizations are examined.

2958 **(CEA-CONF—8932) Training personnel for driving vehicles transporting radioactive materials.** Gilles, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 8p. (In French). (CEA-DAS—297; CONF-8610337—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750117/JAW.

From SFRP meeting on mastering of a transport system for dangerous materials; Paris, France (7 Oct 1986).

The aim of drivers' formation is a sensibilization to hazards presented by dangerous materials transport and accident prevention. Different specializations exist: transport of explosive, fuels or radioactive materials. The training programme is given for radioactive materials transport as are statistics on personnel for each year.

2959 **(CEA-CONF—8933) Study of stowing of radioactive materials package in accidental conditions.** Phalippou, C.; Chevalier, G.; Gilles, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1986. 11p. (In French). (CONF-8610337—3; CEA-DAS—298). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750118/JAW.

From SFRP meeting on mastering of a transport system for dangerous materials; Paris, France (7 Oct 1986).

Two types of accidents are defined from informations collected from relations between vehicles, packaging, deceleration and accident frequency: front impact at 50 km/h and side impact at 25 km/h and 35 km/h. A finite element model the TRICO code is used for modelisation and 8 tests are realized. Recommendations are given in conclusion.

2960 (INIS-mf—11045, pp 127-148) **Broad survey of radioactive waste transports and trends.** Blum, P.T. (Transnucleaire, 75 - Paris, France). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

This survey reviews Radioactive Waste (RW) transports in different countries, giving the origins, amounts, distances and modes of transport for the different RW categories currently moved. It appears that: present transport experience concerns mainly Low and Medium level Wastes (LMW) and Spent nuclear Fuel (SF); RW transports are implemented in compliance with IAEA recommendations which proved particularly helpful to gain public acceptance; the bulk of LMW is transported as Low Specific Activity (LSA) materials (i.e. with packaging requirements just equivalent to those needed for their disposal) and SF as well as liquid RW are transported in 'type B' packagings which withstand severe accident conditions; records indicate that transport worker irradiation is kept much below allowable limits and that accidents during RW transports did not cause significant release of activity to environment; and the cost of RW transports including insurances, is small compared to that of RW processing and disposal. Therefore, one may comment that RW movements are by no means slowed down by transport problems and just follow the demand which in some countries may be delayed by reasons linked to RW disposal strategy or its public acceptance. This survey presents also an assessment of RW transports until the end of this century.

2961 (INIS-mf—11045, pp 273-289) **Dry storage of light water reactor fuel.** Cumiskey, J.; Cardito, J.; Bushnell, G.; Popper, S. (Stone and Webster Engineering Corp., Boston, MA, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The definition of interim fuel storage life is argued to be up to 100 years. The storage of fuel at the generating power station or a central storage facility should be planned to eliminate the need to physically handle aged spent fuel assemblies. This paper identifies a currently available dry storage facility that meets this goal. The unique features of this alternative are described and its superior licensability and reasonable cost are discussed. In conclusion, the world-wide applicability of the dry fuel storage facility design, with only minor dimensional changes, is indicated.

2962 (INIS-mf—11045, pp 405-415) **Transportation and storage experience.** Haelsig, R.T. (Nuclear Packaging Corp., Federal Way, WA, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Nuclear Packaging, a Pacific Nuclear Company, is the leading U.S. designer of radioactive material transport packages (casks and overpacks). The company has recently completed the design, fabrication and licensing of the new spent fuel transport container. This rail car mounted cask is the first such container to be licensed in the United States during the last decade. The composite lead cask was contracted for and designed to transport the damaged nuclear fuel from Three Mile Island Unit 2. A unique consideration in the design is the two separate levels of containment that are provided at all times, allowing the shipment of failed fuel without additional 'canning'. Another first is associated with the fact that no other previous U.S. cask design has undergone testing in support of the traditional analytical design tools. This experience is the latest in more than a decade of specialized design and licensing activities conducted by Nuclear Packaging, Inc., providing safe and efficient transport containers to the U.S. and world nuclear markets.

2963 (INIS-mf—11045, pp 503-522) **Long-term interim storage of spent fuel: approved technology for economical concepts.** Kirchenmayer, A.; Banck, J.; Wasinger, K. (Kraftwerk Union A.G., Offenbach am Main, Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

This paper presents an economical approach for long-term interim storage of spent fuel consisting of extending the capacity of at-reactor spent fuel storage pools through the use of neutron-absorbing high-density racks and by employing wherever possible the rod consolidation technique being developed at KWU. For dry interim storage of spent fuel when at-reactor storage capacity has been exhausted, this paper describes KWU's BUNKER STORAGE FACILITY and investigates the economics of combining at-reactor storage capacity extensions with dry away-from-reactor storage techniques.

2964 (INIS-mf—11045, pp 743-755) **Dry storage of spent fuel: current practice, experience and development trends.** Ospina-Esperon, C.J. (Swiss Federal Institute for Reactor Research, Wurenlingern, Switzerland). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The storage of spent fuel is a very important independent step of the nuclear fuel cycle, which has to be considered in the plans and policies of a nuclear power station and the electricity utilities, and must cope with the interim storage, handling and transportation of it before a final decision is taken. Therefore spent fuel is not a matter of waste management alone, but spent fuel management links the fuel cycle with the waste management together. The operational experience accumulated to date confirms the formulated design targets of various dry storage systems. This experience allows the development and demonstration of similar dry storage systems for high-level waste, which facilitates greatly nuclear waste management under optimum technical and economical conditions.

2965 (INIS-mf—11045, pp 777-793) **Potential exposures and health effects from spent fuel transportation.** Sandquist, G.M.; Rogers, V.C. (Utah Univ., Salt Lake City, USA; Rogers and Associates Engineering Corp., Salt Lake City, UT, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The radiation exposures and consequent health effects associated with normal operations and accidents during transportation of spent fuel have been analyzed and evaluated. This study was performed for the U.S. Department of Energy (DOE) as contributory data for response to specific public inquires regarding the Draft Environmental Assessments issued by DOE in 1984. Large quantities of spent fuel from power reactors will be shipped by truck and/or rail from the site of generation or temporary storage to nuclear waste repositories. This transportation activity has the potential for increasing radiation exposures and risks above normal background levels in the vicinity of the transportation route. For normal, accident-free transport of spent fuel, radiation exposures arise from both gamma and neutron sources within the spent fuel cask. U.S. regulations limit the radiation dose equivalent rate to 10 millirem per hour at any point 2 meters from the outer lateral surfaces of the transport vehicle. Computer program PATHRAE-T was developed and employed to determine the total, combined dose field. PATHRAE-T was used to estimate the maximum individual doses from rail cask accidents. The maximum individual exposure, primarily due to inhalation, is about 10 rem and occurs about 70 meters downwind. Ground deposited nuclides account for 99 percent of the population dose. The maximum population dose accident could result in about 22 latent health effects for the urban population. The same case rail cask accidents were also evaluated for a maximum water pathway contamination scenario. The nuclide contaminated plume was assumed to be transported over a large reservoir used for domestic and agricultural water. This accident could result in a 63,000 person-rem dose causing about 13 latent health effects in the absence of any natural and industrial processes for nuclide removal from the water.

2966 (PNL—6206-Vol.2) **HYDRA-II: A hydrothermal analysis computer code: Volume 2, User's manual.** McCann, R.A.; Lowery, P.S.; Lessor, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 361p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88002245/JAW.

HYDRA-II is a hydrothermal computer code capable of three-dimensional analysis of coupled conduction, convection, and thermal radiation problems. This code is especially appropriate for simulating the steady-state performance of spent fuel storage systems. The code has been evaluated for this application for the US Department of Energy's Commercial Spent Fuel Management Program. HYDRA-II provides a finite-difference solution in cartesian coordinates to the equations governing the conservation of mass, momentum, and energy. A cylindrical coordinate system may also be used to enclose the cartesian coordinate system. This exterior coordinate system is useful for modeling cylindrical cask bodies. The difference equations for conservation of momentum incorporate directional porosities and permeabilities that are available to model solid structures whose dimensions may be smaller than the computational mesh. The equation for conservation of energy permits modeling of orthotropic physical properties and film resistances. Several automated methods are available to model radiation transfer within enclosures and from fuel rod to fuel rod. The documentation of HYDRA-II is presented in three separate volumes. Volume 1 - Equations and Numerics describes the basic differential equations, illustrates how the difference equations are formulated,

and gives the solution procedures employed. This volume, Volume 2 - User's Manual, contains code flow charts, discusses the code structure, provides detailed instructions for preparing an input file, and illustrates the operation of the code by means of a sample problem. The final volume, Volume 3 - Verification/Validation Assessments, provides a comparison between the analytical solution and the numerical simulation for problems with a known solution. 6 refs.

2967 **(SAND—86-2430C) Conceptual design and probabilistic safety assessment for a nuclear waste transport and emplacement ship.** Hutchison, B.L.; Laible, D.H.; Kristensen, D.H.; Jagannathan, S. (Glosten Associates, Inc., Seattle, WA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 30p. (CONF-871169—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001852/JAW.

From Annual meeting of the Society of Naval Architects and Marine Engineers; New York, NY, USA (11 Nov 1987).

A conceptual design is presented for a ship designed to transport high-level radioactive waste and emplace that waste in stable deep ocean sediment formations using gravity penetrators. The conceptual design incorporates features designed to provide exceptional safety with respect to major marine accidents such as collisions, groundings, fire and sinking. The paper discusses the vessel operating cycle, the functional design requirements, a design for safety process, the resulting conceptual design, and the probabilistic risk assessment for major marine accidents and salvage success. The resulting conceptual design process, and certain design features, could be regarded as a prototype for ships intended to transport hazardous or toxic materials. 25 refs., 19 figs., 22 tabs.

2968 **(UCID—21218) Packaging review guide for reviewing safety analysis reports for packagings: Revision 0.** Fischer, L.E.; Chou, C.K.; Lloyd, W.R.; Mount, M.E.; Nelson, T.A.; Schwartz, M.W.; Witte, M.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88002283/JAW.

The Department of Energy (DOE) has established procedures for obtaining certification of packagings used by DOE and its contractors for the transport of radioactive materials. These certification review policies and procedures are established to ensure that DOE packaging designs and operations meet safety criteria at least equivalent to the standards prescribed by the Nuclear Regulatory Commission (NRC) certification process for packaging. The Packaging Review Guide (PRG) is not a DOE order, but has been prepared as guidance for the Packaging Certification Staff (PCS) under the Certifying Official, Office of Security Evaluations, or designated representatives. The principal purpose of the PRG is to assure the quality and uniformity of PCS reviews, and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. The PRG also sets forth solutions and approaches determined to be acceptable in the past by the PCS in dealing with a specific safety issue or safety-related design area. These solutions and approaches are presented in this form so that reviewers can take consistent and well-understood positions as the same safety issues arise in future cases. An applicant submitting a SARP does not have to follow the solutions or approaches presented in the PRG. However, applicants should recognize that the PCS has spent substantial time and effort in reviewing and developing their positions for the issues. A corresponding amount of time and effort will probably be required to review and accept new or different solutions and approaches. Finally, it is also a purpose of the PRG to make information about DOE certification policy and procedures widely available to DOE field offices, DOE contractors, federal agencies, and interested members of the public. 7 refs., 15 figs., 14 tabs.

0520 Waste Management

REFER ALSO TO CITATION(S) 2933, 2937, 2938, 2940, 2942, 2943, 2944, 2945, 2946, 2947, 2952, 2956, 2967, 3161, 3173, 3174, 3425, 3450, 3465, 3467, 3475, 3514, 3717, 3834, 3898, 3919, 4332, 4375, 4377, 4378, 4380, 4381, 4382, 4383, 4385, 4386, 4388, 4389, 4413, 4414, 4415, 4419, 4568

2969 **(AAEC/E—653) Modelling water and contaminant transport in the Rum Jungle Mine overburden heaps.** Pantelis, G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700292/JAW.

An outline is given of a computer model for water and contaminant transport in and around overburden heaps, with those at the Rum Jungle mine site as a specific example. The model assumes the heaps to lie on a sloping shallow aquifer with identical hydraulic properties. The simulation is carried out for a 40 year period. After the first 20 years a cover which is effectively impermeable to infiltrating rainwater and air is introduced on the heap. The restriction of oxygen supply to the heap terminates contaminant production which results from oxidation of pyrite. Leaching of contaminants from the heap in the following 20-year period is examined.

2970 **(AERE-Bib—206) Nirex Safety Assessment Research Programme Bibliography, 1987.** Cooper, M.J.; Hodgkinson, D.P. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics Div.). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750651/JAW.

This bibliography lists reports and papers written as part of the Nirex Safety Assessment Research programme, which is concerned with disposal of low-level and intermediate-level waste (LLW and ILW). All work referred to has been funded, or partly funded, by UK Nirex Limited, previously known as the Nuclear Industry Radioactive Waste Executive (NIREX). The bibliography has been divided into two sections, a List of Publications in roughly chronological order and an Author Index. The topics involved include near-field and far-field studies. The near-field includes the waste, its immobilising medium, its container, the engineered structure in which the containers are emplaced, and the immediately adjacent geological formation disturbed by the construction of the repository. The far-field is the undisturbed geological formation between the near-field and the biosphere. 70 refs.

2971 **(AERE-M—3501-Rev.) Assessment of the preliminary microbiological studies on clay cores from Elstow conducted by the Universities of Leicester and Warwick.** Rushbrook, P.E. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Apr 1987. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750223/JAW.

Two preliminary studies were conducted to establish the presence or absence of micro-organisms in samples of Oxford Clay from Elstow. Bacterial colonies were the dominant organisms found. In addition, a limited series of tests was performed to assess the tolerance of specific bacterial sub-cultures to variations in two environmental parameters; pH and temperature. It was found that micro-organisms can survive and colonise at depth in Oxford Clay strata, but at an abundance of between two and four orders of magnitude below that of typical garden soil. Therefore, in the "after closure" phase of a repository where an environment of pH greater than 9 will probably exist, some localised micro-biological action may take place. However, from the data obtained, degradation by this mechanism is likely to be slower when compared to deterioration from physical and chemical mechanisms.

2972 **(AERE-R—12305) Channelling of flow through fractures in rock.** Bourke, P.J. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). May 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750224/JAW.

A method of mapping the channelling of flow in rock fractures formed by contacts between rock faces and of measuring the

effective apertures of channels has been developed. Some typical results are given.

2973 **(AERE-R—12477) Survey of microbiological effects in low-level radioactive waste disposed of to land.** McGahan, D.J. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jan 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750124/JAW.

An evaluation of published literature was mounted to determine the current position of research into microbiological effects in low-level radioactive waste disposal sites and to assess the need for further research. It is concluded from the survey that the microbial activity present in domestic landfills also occurs in shallow land burial low-level radioactive waste disposal sites. The microbial activity results in the release of tritium as tritiated methane to the atmosphere and tritiated components to the leachate. Carbon-14 migration is also enhanced. It also accelerates the corrosion of steel and concrete used to contain the wastes. There is little evidence for enhanced migration of radionuclides as a result of their incorporation in bacteria but there is considerable evidence for enhancement resulting from the presence of complexing agents (such as ethylenediamine-tetraacetic acid and tributyl phosphate) in the waste. Research in this field has been observed to be very active in the United States. Its objective is to predict with more certainty the important parameters for future low-level radioactive waste site designs. Quantitative prediction of microbial effects and their magnitude is not easy to deduce from the published literature, and new site designs will differ markedly from those that have been in operation over the last thirty years.

2974 **(AERE-R—12570) Application of gel processes in the treatment of actinide-containing liquid wastes.** Segal, D.L.; Willis, H.; Woodhead, J.; Wisbey, S. (UKAEA Atomic Energy Research Establishment, Harwell. Engineering Sciences Div.; Department of the Environment, London (UK)). Apr 1987. 15p. H.M. Stationery Office, London, price Pound 4.00.

Aqueous sol-gel materials including zirconia and alumina sols together with glass-ionomer cements have been used to immobilise inactive mixed Al/Fe/Cr-hydroxide flocs representative of those produced during fuel reprocessing. Conditions for washing out entrained ammonium nitrate while maintaining gravelly-precipitates have been investigated. Decontamination factors have been determined by α-spectrometry for the effect of zirconia and alumina sols on Pu/^{241}Am nitrate solutions in 2M nitric acid/0.2M ammonium fluoride/0.2M aluminium nitrate.

2975 **(BMI/ONWI—655) Expected waste package performance for nuclear waste repositories in three salt formations.** Jansen, G. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1987. Contract AC02-83CH10140. 447p. NTIS, PC A19. Order Number DE87014961/JAW.

Expected waste package lifetimes and radioactive releases from the package were predicted at seven sites in three geologic formations for both commercial high-level waste (CHLW) and spent nuclear fuel from pressurized-water reactors (SFPWR) using near-field conditions from preliminary analyses. The predicted expected lifetimes for both CHLW and SFPWR waste packages exceeded 10,000 years at all seven repository sites. These conclusions are based on expected uniform corrosion of packages with thick containers of low-carbon steel and uniform distribution of the limited quantity of local brine that migrates thermally toward the waste package and becomes available to react with the steel in the waste container. The maximum quantities of radionuclides that would be discharged at failed packages would be limited to a small fraction of the EPA standard at the site boundary except for isotopes of highly soluble iodine, cesium, and perhaps sparingly soluble strontium. The conclusion of this assessment of waste package performance under expected conditions is that all seven sites are within regulatory requirements. However, the domes, in spite of their higher temperatures, have a greater tolerance for error both in the analytical model and in the input data estimates than the bedded sites because of their expected lower water contents and because of their less corrosive low-magnesium in situ brines. 37 refs., 49 figs., 19 tabs.

2976 **(BNL—39915) Assessing economic consequences of radiation accidents.** Rowe, M.D.; Lee, J.C.; Grimshaw, C.A.; Kalb, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-871101—45-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012485/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This project reviewed the literature on the economic consequences of accidents to determine the availability of assessment methods and data and their applicability to the high-level radioactive waste (HLW) disposal system before closure; determined needs for expansion, revision, or adaptation of methods and data for modeling economic consequences of accidents of the scale projected for the disposal system; and gathered data that might be useful for the needed revisions. 8 refs., 1 tab.

2977 **(CEA-CONF—8919) Pilot workshop TOR and the experience acquired in reprocessing.** Patarin, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Dec 1986. 15p. (In French). (CONF-861262—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753244/JAW.

From SFEN conference on fast reactors and the startup of superphenix; Paris, France (10 Dec 1986).

This report reviews the experience acquired by the Group CEA in the reprocessing and the fast reactor fuels. TOR Treatment of Fast Oxide is the present stage in the development of reprocessing installations; TOR is a pre-industrial installation and will allow to develop the main technical choices.

2978 **(CEA-R—5385) Rare earth elements during diagenesis of abyssal sediments: analogies with a transuranic element americium.** Boust, D. (CEA Centre de La Hague, 50 - Cherbourg (France)). Mar 1987. 296p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE87753230/JAW.

One of the possibilities for the storage of high-level radioactive wastes consists in burying them into abyssal sediments, the sediments being supposed to barrier out radionuclides migration. The objective of the work was to estimate the efficiency of sediment barrier with respect to americium. As there is no americium in abyssal sediments, an indirect approach was used: the behaviour of the rare earth elements, the best natural analogs of americium. They were analysed in a 15 m long core, from the Cap Verde abyssal plateau. The terrigenous phase derived from the African continent was modified by short-term processes (1-1000 years); the intermediate rare earth elements were dissolved. Mineral coatings, enriched in rare earth appeared. After burial, the evolution continued at a much slower rate (10/sup 5/ - 10/sup 6/ years). The rare elements of the mineral coatings derived from the dissolution of the terrigenous phase and from an additional source, deeper in the sediment column. The fluxes of rare earth elements from sediment to water column were estimated. In suboxic sediments, the dissolved particulate equilibrium was related to redox conditions. The short-term reactivity of americium was studied in laboratory experiments. Simple americium migration models showed that the sediments barrier was totally efficient with respect to americium. In the conditions, neptunium 237 a daughter product of americium 241 could induce fluxes of 10/sup 16/ atoms per year per ton of stored waste (10/sup -8/Ci y-1), during millions years, towards the water column.

2979 (CONF-860990—Pt.1, pp 1-12) **Performance assessment for an above grade disposal structure.** Blickwedehl, R.R. (Dames & Moore, West Valley, NY). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The low-level waste generated in conjunction with solidification of high-level waste at the West Valley Demonstration Project will be disposed of in an above grade earthen mound. This method of disposal was selected in consideration of the site geology and waste characteristics. The earth mound is designed to perma-

nently isolate the waste from the environment by means of redundant clay caps over the waste cell. However, it is possible that engineered barriers might fail under contingency conditions. A pathway analysis was performed to analyze the dose to man which might result under these conditions. A finite element code was used to model seepage through the clay caps and the waste cell. The water flux and velocity in the waste cell were used to estimate the leaching by diffusion theory. Leachate from this source discharges to the environment and flow overland to surface waters which drain the disposal site. Some of the radionuclides in the leachate are sorbed onto the surface soils during the overland flow. The most significant exposure was to a hypothetical individual who illegally resided on the site and planted a vegetable garden. Most of this potential dose was from inhalation of contaminated surface soil which was resuspended when the soil was tilled. The maximum dose received by the on-site resident was estimated to be 3 mrem/year, a fraction of background. The predicted dose to an off-site resident was two orders of magnitude less. 12 references, 7 figures, 1 table.

2980 (CONF-860990—Pt.1, pp 13-35) **Results of EPA's risk assessments of alternative methods of LLW disposal.** Meyer, G.L.; Hung, C.Y.; Bandrowski, M.S.; Rogers, V.C. (Environmental Protection Agency, Washington, DC). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Evaluation of the potential health risk and individual exposure from a broad number of disposal alternatives is an important part of EPA's program to develop generally applicable environmental standards for the land disposal of low-level radioactive wastes (LLW). The Agency has completed an analysis of the potential population health risks and maximum individual exposures from ten disposal methods under three different hydrogeological and climatic settings. This paper briefly describes the general input, analysis procedures, and output used in the LLW assessments and presents preliminary results. Some important lessons learned from simulating LLW disposal under a large variety of methods and conditions are identified. 24 references, 6 figures, 7 tables.

2981 (CONF-860990—Pt.1, pp 36-53) **Economic analysis of alternative LLW disposal methods.** Foutes, C.E.; Queenan, C.J. III. (Environmental Protection Agency, Washington, DC). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Environmental Protection Agency (EPA) has evaluated the costs and benefits of alternative disposal technologies as part of its program to develop generally applicable environmental standards for the land disposal of low-level radioactive waste (LLW). Costs, population health effects and Critical Population Group (CPG) exposures resulting from alternative waste treatment and disposal methods were evaluated both in absolute terms and also relative to a base case (current practice). Incremental costs of the standard included costs for packaging, processing, transportation, and burial of waste. Benefits are defined in terms of reductions in the general population health risk (expected fatal cancers and genetic effects) evaluated over 10,000 years. A cost-effectiveness ratio, defined as the incremental cost per avoided health effect, was calculated for each alternative standard. The cost-effectiveness analysis took into account a number of waste streams, hydrogeologic and climatic region settings, and waste treatment and disposal methods. This paper describes the alternatives considered and preliminary results of the cost-effectiveness analysis. 15 references, 7 figures, 3 tables.

2982 (CONF-860990—Pt.1, pp 54-60) **NRC perspective on alternative disposal methods.** Pittiglio, C.L.; Tokar, M. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

In this paper is discussed an NRC staff strategy for the development of technical criteria and procedures for the licensing of various alternatives for disposal of low-level radioactive waste. Steps taken by the staff to identify viable alternative disposal methods and to comply with the requirements of the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985 are also discussed. The strategy proposed by the NRC staff is to focus efforts in FY 87 on alternative concepts that incorporate concrete materials with soil or rock cover (e.g., below ground vaults and earth-mounded concrete bunkers), which several State and State Compacts have identified as preferred disposal options. While the NRC staff believes that other options, such as above ground vaults and mined cavities, are workable and licensable, the staff also believes, for reasons addressed in the paper, that it is in the best interest of the industry and the public to encourage standardization and to focus limited resources on a manageable number of alternative options. Therefore, guidance on above ground vaults, which are susceptible to long-term materials degradation due to climatological effects, and mined cavities, which represent a significant departure from the current experience base for low-level radioactive waste disposal, will receive minimal attention. 6 references.

2983 (CONF-860990—Pt.1, pp 61-70) **Waste disposal technologies: designs and evaluations.** Shaw, R.A. (Electric Power Research Institute, Palo Alto, CA). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Many states and compacts are presently in the throes of considering what technology to select for their low level waste disposal site. Both the technical and economic aspects of disposal technology are important considerations in these decisions. It is also important that they be considered in the context of the entire system. In the case of a nuclear power plant, that system encompasses the various individual waste streams that contain radioactivity, the processing equipment which reduces the volume and/or alters the form in which the radioisotopes are contained, the packaging of the processed wastes in shipment, and finally its disposal. One further part of this is the monitoring that takes place in all stages of this operation. This paper discusses the results of some research that has been sponsored by EPRI with the principal contractor being Rogers and Associates Engineering Corporation. Included is a description of the distinguishing features found in disposal technologies developed in a generic framework, designs for a selected set of these disposal technologies and the costs which have been derived from these designs. In addition, a description of the early efforts towards defining the performance of these various disposal technologies is described. 5 figures, 1 table.

2984 (CONF-860990—Pt.1, pp 71-75) **General requirements and considerations for a design concept in Pennsylvania.** Dornsife, W.P.; Krett, R.E. (Pennsylvania Dept. of Environmental Resources, Harrisburg). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Appalachian Compact, for which Pennsylvania is the host state, prohibits traditional shallow land burial. Low-level radioactive waste (LLRW) must be disposed of using engineered confinement. Draft criteria have been developed by the Pennsylvania Department of Environmental Resources, with assistance from a Public Advisory Committee, to define the requirements for engineered confinement and other requirements for engineered confinement and other requirements for an acceptable disposal technology. This Draft Technology Design/Performance Criteria establishes Performance Objectives, Technical Requirements and presents Other Considerations which apply to the design concept for the disposal facility. These requirements are summarized.

2985 (CONF-860990—Pt.1, pp 76-89) **Engineered sorbent barriers for low-level waste disposal.** Mitchell, S.J.; Freeman, H.D.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Engineered Sorbent Barriers Program at Pacific Northwest Laboratory is developing sorbent materials to prevent the migration of radionuclides from low-level waste sites. These materials would allow water to pass, preventing the bathtub effect at humid sites. Screening studies identified promising sorbent materials for three key radionuclides: for cesium, greensand; for cobalt, activated charcoal; and for strontium, synthetic zeolite of clinoptilolite. Mixtures of these sorbent materials were tested in 0.6-m-diameter columns using radioactive leachates. To simulate expected worst-case conditions, the leachate solution contained the radionuclides, competing cations, and a chelating agent, adjusted to a pH of 5. A sorbent barrier comprised of greensand (1 wt%), activated charcoal (6 wt%), synthetic zeolite (20 wt%), and soil (73 wt%) achieved the decontamination factors necessary to meet the regulatory performance requirements established for this study. Sorbent barriers can be applied to shallow land burial, as backfill around the waste or engineered structures, or as backup to other liner systems. 2 references, 6 figures, 3 tables.

2986 (CONF-860990—Pt.1, pp 90-95) **Coordinating committee for low-level waste disposal technology - a forum for progress.** Schwarz, W.F. (New York State Energy Research and Development Authority). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Coordinating Committee was formed in May 1985, basically to coordinate member activities in LLRW disposal technology research, development, and assessment. Its 11 members represent five states, DOE, NRC (research and licensing), EPA, EPRI, and the Southern States Energy Board. The Committee encourages other states and organizations to participate in or benefit from its activities by inviting observers, promoting workshops, and inviting presentations from experts on pertinent issues. To focus its resources, the Committee has identified and prioritized 15 key technology and implementation issues. Each quarterly meeting concentrates on one of these issues, and if possible is held in conjunction with a workshop examining that issue. This paper describes how the Committee's efforts and technical focus relate to State progress toward new disposal capacity; identifies some key technical issues which the Committee is addressing; and suggests way to further broaden the usefulness of the Committee's efforts.

2987 (CONF-860990—Pt.1, pp 96-98) **Improvements in shallow-land disposal technology at the Barnwell LLW disposal site.** Jump, M.J. (Chem-Nuclear Systems, Inc., Columbia, SC). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Two aspects of LLW disposal are discussed - public acceptance and the technology to be used for disposal of low-level radioactive waste in the 1990's. The technology which is required to develop and operate LLRW disposal sites in the 1990's is available today. The key issue is public acceptance of the disposal technology to be employed in the 1990's when the next disposal sites will be operational. Tours of the Barnwell Disposal Site are one of the best methods for giving the public better understanding of LLRW disposal operations. This paper briefly reviews the disposal of LLW as practiced at CNSI's Barnwell Site and improvements in the disposal technology. A few of the improvements include: 1) upgrading all previously filled disposal cells to meet and exceed the current containment criteria; 2) design, licensing and extensive utilization of new High Integrity Containers (HICs) for LLRW, designed to maintain their integrity for more than 300 years; and 3) development of special cement formulations which are utilized to solidify LLRW in a form which meets 10CFR61 stability requirements and has been used extensively throughout the US.

2988 (CONF-860990—Pt.1, pp 99-114) **Effects of trench design and infiltration fluxes on soil-moisture migration into burial trenches at Barnwell, South Carolina.** Dennehy, K.F.; McMahon, P.B. (Geological Survey, Columbia, SC). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Numerical analysis of soil-moisture migration in the unsaturated zone at two experimental burial trenches at the Barnwell, South Carolina low-level radioactive-waste burial site was used to examine how water movement is affected by trench design and by precipitation and evapotranspiration fluxes. The unsaturated zone consists of 1 to 2 meters of surface sand underlain by 10 to 12 meters of clayey sand. Both trenches were excavated in the unsaturated zone to a depth of 7 meters, backfilled with 5 meters of stockpiled surface sand, and capped with 2 meters of compacted clayey sand. The surface sand around trench 1 replaced with a 3-meter wide compacted clayey-sand barrier. Modeling results show that during periods of infiltration, soil moisture moved downward through the trench cap of both trenches and into the trench backfill sand. In the undisturbed sediments adjacent to the trenches, water moved downward through the surface sand and either continued downward into clayey sand or moved laterally along the surface-sand/clayey-sand interface into the trench backfill sand, depending on trench design. The use of the compacted clayey-sand barrier at trench 1 greatly inhibited soil-moisture that moved along the interface from entering the trench, whereas the absence of the barrier at trench 2 allowed the soil moisture to enter the trench. Water ponded on the bottom of trench 1 to a maximum depth of 0.3 meter. At trench 2, water ponded to a maximum depth of 2.3 meters. The depth to which evapotranspiration and precipitation influenced soil-moisture migration in the unsaturated zone was dependent on the duration and magnitude of each flux. 4 references, 8 figures.

2989 (CONF-860990—Pt.1, pp 115-119) **Nevada Test Site experience with greater confinement disposal.** Dickman, P.T.; Boland, J.R. (Reynolds Electrical & Engineering Co., Inc.). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

In 1980, the Nevada Test Site (NTS) began a project to develop an improved disposal method for high specific activity (HSA) low-level wastes (LLW), e.g. tritium wastes. Past experience with the shallow land burial (SLB) of tritium wastes showed detectable concentrations appearing at trench surfaces. In 1981, the Greater Confinement Disposal Test (GCDT) was initiated to demonstrate the disposal of HSA wastes considered unsuitable for SLB. The project had two specific goals: (1) develop and demonstrate the operational technology for use of large-diameter boreholes for greater confinement disposal (GCD), and (2) conduct research necessary to quantify the effective improvement provided by GCD over SLB. While the long-term impacts may be insignificant for short-lived nuclides, the operational impacts may be a major limiting factor. For example, under 10 CFR 61 up to 700 Ci/m^3 of cobalt-60 may be disposed in SLB as Class A wastes; however, an unshielded waste package containing this amount of cobalt-60 would have an external radiation level of over 5000 R/h making it impossible to dispose of without use of a remote handling systems. In developing the GCDT, the authors decided that greater confinement disposal was not to be strictly limited to a category of wastes between low- and high-level, but a variety of problem wastes that could not, or should not, be disposed of by conventional SLB methods. The paper discusses NTS waste disposal history, hazards reduction, and waste management philosophy. 3 tables.

2990 (CONF-860990—Pt.1, pp 120-127) **Effectiveness of a ground-surface polymer membrane covering as a method for limiting infiltration into burial trenches at Maxey Flats, Kentucky.** Lyverse, M.A. Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Maxey Flats Disposal Site (MFDS) was operated as a shallow land burial site for low-level radioactive wastes for a period of 14 years (1963-1977). In 1977, radionuclides were found to be migrating from a closed disposal trench into an adjacent newly constructed trench. This discovery prompted closure of the site. Over time, deterioration of the shale and clay cover on the trenches had resulted from subsidence due to the collapse of buried metallic containers and the decomposition of various organic wastes within the trenches. This subsidence increased infiltration of water into the trenches as surface water was retained over the waste in potholes and small ponds. Although infiltration rates to the waste increased, seepage rates of leachate out of the bottom and sides of the trenches were very slow due to the low permeability of surrounding native shale soils (average hydraulic conductivity 4 x 10^{-3} ft/day). In 1981, a program was implemented to correct deficiencies and stabilize the site. This paper describes the effectiveness of one design method where a low permeable (hydraulic conductivity $< 0.33 \times 10^{-8}$ ft/sec) polyvinylchloride membrane cover (PVC) 0.015 to 0.020 inches thick was placed over the burial trenches. The covers were installed over trenches beginning in the fall of 1981. Each trench is equipped with several sumps for the collection and removal of leachate. Water-level data were collected on sumps from five trenches during the study period May 1978 to October 1984, which spanned a period prior to and after installation of the PVC cover. 3 references, 4 figures, 1 table.

2991 (CONF-860990—Pt.1, pp 128-140) **Technology development for the design of shallow land burial facilities at semiarid sites.** Abeele, W.V.; Nyhan, J.W.; Drennon, B.J. (Los Alamos National Lab., NM). Feb 1987. NTIS, PC A07/MF A01. Order Number DE87012442/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Three experiments are described: effectiveness of a moisture barrier and the physical basis for capillary barriers; trench cap designs for long term stabilization including biointrusion barrier testing; and joint DOE/NRC tracer migration experiment. In the first, a barrier concept known as the wick effect is being field tested to control the movement of water on top of and around shallow land burial trenches. The barrier is composed of bentonite and tuff. In the second, the performance is measured of a conventional and an improved trench cover design on surface water dynamics, in limiting biological intrusion, and under both natural and enhanced precipitation regimes. The third experiment evaluates leaching and transport of solutes in sandy silt backfill used in shallow land burial at Los Alamos and compares results with laboratory-derived parameter estimates. 6 references, 4 figures, 2 tables.

2992 (CONF-860990—Pt.2, pp 21-31) **Long term management plan: West Valley disposal area.** Hornibrook, C. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Energy Authority and its contractor utilized a systematic approach in selecting a long-term management plan for the West Valley LLRW disposal area. Existing site data were compiled, site problems crucial to site stabilization identified, technologies to correct these problems were identified and assessed, and seven viable long-term management plans were developed and evaluated. Technical evaluation narrowed the field of viable plans to the Precast Concrete Barrel Vault (highest score) and Active Maintenance/ Natural Stabilization (next highest score). When considering these two plans, the policy question that most influenced final plan selection was the uncertainty of NRC/DOE requirements for the ultimate transfer of custodial responsibility of the LLRW disposal area to DOE (should the State decide to take this action). Implementing an elaborate stabilization technique such as the Precast Concrete Barrel Vault, which may or may not meet the NRC/DOE requirements, would not be a prudent action at this time. Therefore, it was important to selection a plan that provided maximum flexibility, not only for possible site transfer but for implementing an emerging trench stabilization technology should one be judged desirable. lastly, it is important to maintain the flexibility to meet unanticipated site needs or problems. For these reasons, Active Maintenance/ Natural Stabilization appears to be the prudent choice at this time. 5 tables.

2993 (CONF-860990—Pt.2, pp 32-50) **Maxey Flats low-level waste disposal site closure activities.** Haight, C.P.; Mills, D.; Razor, J.E. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Maxey Flats Radioactive Waste Disposal Facility in Fleming County, Kentucky is in the process of being closed. The facility opened for commercial business in the spring of 1963 and received approximately 4.75 million cubic feet of radioactive waste by the time it was closed in December of 1977. During fourteen years of operation approximately 2.5 million curies of by-product material, 240,000 kilograms of source material, and 430 kilograms of special nuclear material were disposed. The Commonwealth purchased the lease hold estate and rights in May 1978 from the operating company. This action was taken to stabilize the facility and prepare it for closure consisting of passive care and monitoring. To prepare the site for closure, a number of remedial activities had to be performed. The remediation activities implemented have included erosion control, surface drainage modifications, installation of a temporary plastic surface cover, leachate removal, analysis, treatment and evaporation, US DOE funded evaporator concentrates solidification project and their on-site disposal in an improved disposal trench with enhanced cover for use in a humid environment situated in a fractured geology, performance evaluation of a grout injection demonstration, USGS subsurface geologic investigation, development of conceptual closure designs, and finally being added to the US EPA National Priority List for remediation and closure under Superfund. 13 references, 3 figures.

2994 (CONF-860990—Pt.2, pp 51-54) **In-situ vitrification of radioactively contaminated soils: summary paper.** Buelt, J.L.; Fitzpatrick, V.F. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The in-situ vitrification (ISV) process is a new technology that has been developed from its conceptual phase through selected field-scale application tests during the last six years. In situ vitrification converts contaminated soils and waste inclusions into a durable glass and crystalline waste form by in-place melting. Electrodes are inserted into the soil to be treated and an electrical current is passed through the soil to be treated and an electrical current is passed through the soil to melt it. After cooling, the process fixes (TRU) and fission product radionuclides making them relatively nonleachable, resistant to intrusion, and nondispersible when intentionally disturbed. Another application considered for isolation of radioactively contaminated soils, but not yet developed, is the generation of impermeable barrier walls to prevent ground water seepage into a site. The barrier technique could also be used over the surface of an existing disposal site to deter plant and animal intrusion. The development units have been extensively tested with many types of soils and waste inclusions such as concrete, buried metals, sealed containers, organic chemicals with high boiling points such as polychlorinated biphenyls, and inorganic chemicals, including toxic heavy metals, nitrates, and sulfates. Nitrates and organics are destroyed, while heavy metals and fluorides are retained to a high percentage within the molten soil during processing. At \$200 to \$300/m^3 for radioactive waste, the process is economically competitive with many alternative remediation processes. The ISV process has been developed to the point where it is ready for large-scale field testing at an actual TRU-contaminated soil site. 5 references, 2 figures, 2 tables.

2995 (CONF-860990—Pt.2, pp 60-74) **Development of corrective measures and site stabilization technologies for shallow land burial facilities at semiarid sites: summary paper.** Nyhan, J.W.; Abeele, W.V. (Los Alamos National Lab., NM). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The overall purpose of the corrective measures task performed for the national Low-Level Waste Management Program (NLLWMP) has been to develop and test methods that can be used to correct any actual or anticipated problems with new and existing shallow land burial (SLB) sites in a semiarid environment. These field tests have not only evaluated remedial actions, but have also investigated phenomena suspected of being a possible problem at semiarid SLB sites. The approach the authors have taken in developing remedial action and site closure technologies for low-level waste sites is to recognize the physical and biological processes affecting site integrity are interdependent, and therefore, cannot be treated as separate problems. More specifically the field experiments performed for this task were to identify, evaluate, and model erosion control technologies, field test second generation biointrusion barriers, determine by field experiments the extent of upward radionuclide migration due to moisture cycling, and measure the effects of subsidence on remedial action of other system components. In the following sections of this final task summary report, the authors describe the progress made in establishing the facility in which many of these field experiments were performed, the Los Alamos Experimental Engineered Test Facility (EETF), as well as a brief description of the four research areas encompassed by this task. 45 references, 4 figures.

2996 (CONF-860990—Pt.2, pp 3-11) **Guidance for closure of existing DOE LLW disposal sites.** Blanchfield, L. Feb 1987. NTIS, PC AO5/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

During FY 1986, a closure guidance document was developed. The purpose of this document is to provide guidance in support of DOE Order 5820.2 to site operating contractors for the stabilization and closure of existing low-level waste (LLW) shallow land disposal sites at US Department of Energy (DOE) facilities. Guidance is provided to aid operators in placing existing LLW sites in a closed conditions, i.e., a condition in which a nonoperational site meets postclosure performance requirements and can be shown, within a high degree of confidence, to perform as anticipated in the future, under the most cost-effective maintenance approach. Guidance is based on the philosophy that closure should be planned and performed using a systems approach. Plans for FY 1987 call for revision of the document to incorporate more information on closure of LLW sites also containing radioactive mixed waste and/or transuranic waste. 4 references, 3 figures, 2 tables.

2997 (CONF-860990—Pt.2, pp 12-20) **Long-term monitoring for closed special sites.** Golchert, N.W.; Sedlet, J. (Argonne National Lab., IL). Feb 1987. NTIS, PC AO5/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A methodology is presented for planning and implementing a long-term environmental monitoring program for closed special radioactive waste disposal sites. The steps in the method involve collection of the available background information on the site history, site and area characteristics, waste inventory, pathway analysis, prior monitoring programs, applicable standards, and the legal/regulatory requirements. This information is coupled with factors such as experience, half-life, radionuclide migration rates, and potential hazard to develop a monitoring program. As an example, a site-specific long-term monitoring program is described for the AMAX site using the available information. Sampling techniques and practices for the monitoring program are discussed and techniques and practices expected to be available in the future are considered. 7 references, 2 tables.

2998 (CONF-860990—Pt.3, pp 4-9) **Results of the CRCPD survey of 1984 low-level radioactive waste: progress to mid-September, 1986.** Devine, T.L. Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The survey of 1984 low-level radioactive waste by the Conference of Radiation Control Program Directors, Inc., is the second such survey. The previous survey was for waste generated during 1982. The CRCPD survey of 1984 LLRW requested information concerning the license, the effluents and other on-site managed wastes, details of exported waste type, the capacity for storing waste prior to shipment and its average utilization during 1984. Details of the exported waste included waste type, processing and packaging, NRC class, burial site or broker to which the waste was sent, and anticipated waste generation by year and by class through 1989. Shortcomings of the questionnaire and preliminary results are discussed. Based on the results of the two surveys of low-level radioactive waste conducted by the CRCPD, and the serious discrepancies which exist between data on waste shipped by generators and that on waste received by disposal sites, the following recommendation is made. That a single, national repository be established for all data on the generation and ultimate disposition of low-level radioactive waste. 1 figure, 1 table.

2999 (CONF-860990—Pt.3, pp 10-11) **Commercial low level radioactive waste information system supporting the needs of today's users.** Nugent, O.; Tyron-Hopko, A. (Illinois Dept. of Nuclear Safety, Springfield). Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The information system located on computer at the Idaho National Engineering Laboratory and containing information on low-level radioactive waste management is described. NOMAD2 was chosen as the computer language. The original design contained several databases: generation, treatment, transportation, and disposal. Treatment and transportation have now been removed and are addressed in the Reginalt system. The generation and disposal databases have been combined and are continually updated.

3000 (CONF-860990—Pt.3, pp 12-15) **Information systems to support low-level waste management: perspective from the State of Illinois.** Willaford, D.M. (Illinois Dept. of Nuclear Safety, Springfield). Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Illinois Department of Nuclear Safety (IDNS) is required by state law to develop a comprehensive regulatory system for low-level radioactive waste (LLW) management. Reliable, extensive information about LLW in Illinois is needed to plan and implement such a regulatory program. IDNS annually surveys, by mail and follow-up phone calls, approximately 260 LLW generators in Illinois. This information is being supplemented by a more detailed characterization of waste streams. Additional information needed for IDNS's regulatory program includes data on components of a waste disposal facility (e.g., concrete performance), site and performance computer models for various kinds of sites and for alternative waste disposal facility designs. In the future, all states will need more information than has been historically the case, given the changes in management and disposal systems and the increased role of the states.

3001 (CONF-860990—Pt.3, pp 16-36) **US ecology data system.** Crase, A. Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The US Ecology computer data system was instituted March 1, 1982. This system was designed to manage the increasing flow of paperwork and data associated with the receipt and disposal of

low-level radioactive waste at Richland, Washington and Beatty, Nevada. The system was modified and upgraded in 1984 to accommodate a revised shipping manifest pursuant to the requirements of 10 CFR 20.311. The data system is used to generate various reports for both internal and external distribution. The computer system is located at US Ecology's corporate headquarters in Louisville, Kentucky. Remote access terminals are located at the disposal sites. The system is supported by a Wang VS-100 processor. In addition to supporting the radwaste data system, the system supports a chemical waste data base, word processing, and electronic mail. The management and operation of this data base are described. 19 figures.

3002 (CONF-860990—Pt.3, pp 37-44) **REGINALT - a tool for management planning.** Loughead, J.S.C. Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

REGINALT is a computer-based decision support system that can be used by non-programmers to evaluate a comprehensive approach to commercial low-level radioactive waste (LLRW) management. REGINALT allows a waste management person to consider technical, financial, and scheduling differences between possible scenarios. This paper explains the type of data which are needed, how these data are processed, and the type of reports available from the REGINALT system. 2 figures, 3 tables.

3003 (CONF-860990—Pt.3, pp 45-57) **Low-level radioactive waste data base management.** Roles, G.W. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This paper outlines the uses of information obtained from a national system for management of low-level waste shipment manifest information from the perspective of the NRC Division of Waste Management (DWM). A background section is first presented which briefly reviews some of the basic attributes of a workable system, as well as the existing data management systems established by the disposal facility operators. This background leads into a more detailed discussion of the major uses to which a regulatory agency would put the manifest information, including technical studies and analyses of a broad n: .re as well as day-to-day compliance with regulations and disposal site license conditions. The next two sections respectively summarize NRC's current data base capabilities as well as the limitations in these capabilities. The final section addresses the question: Where do we go from Here? One option under consideration is a rule making which would: (1) set forth the minimum information to be included in shipment manifests in greater detail than that currently specified in 10 CFR 20.311, and (2) require that operators of all low-level waste disposal facilities reduce the information on incoming shipment manifests to an electronic data format which would be periodically forwarded to a centralized location. However, this option would conflict with other NRC priorities and probably require considerable time to implement. Much of the groundwork for a national system has already been prepared, and NRC's preferred approach is to work with States, Compacts, disposal site operators, and DOE to upgrade these existing capabilities. 8 references, 1 figure, 2 tables.

3004 (CONF-860990—Pt.3, pp 58-61) **DOE systems approach to a low-level waste management information system: summary paper.** Esparza, V. Feb 1987. NTIS, PC A04/MF A01. Order Number DE87012444/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The LLWMP is performing an assessment of waste information systems currently in use at each DOE site for recording LLW data. The assessment is being conducted to determine what changes to the waste information systems, if any, are desirable to support implementation of this systems approach to LLW management. Recommendations will be made to DOE from this assessment and what would be involved to modify current DOE waste generator information practices to support an appropriately structured overall DOE LLW data systems. In support of reducing the uncertainty of decision-making, DOE has selected a systems approach to keep pace with an evolving regulatory climate to low-level waste. This approach considers the effects of each stage of the entire low-level waste management process. The proposed systems approach starts with the disposal side of the waste management system and progresses towards the waste generation side of the waste management system. Using this approach provides quantitative performance to be achieved. In addition, a systems approach also provides a method for selecting appropriate technology based on engineering models.

3005 (CONF-860990—Pt.4, pp 45-56) **Siting and technology selection in Texas.** Alvarado, R.A. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Texas Low-Level Radioactive Waste Disposal Authority was created in 1981. Its sole purpose is to site, design, construct, operate, and decommission in a low-level radioactive waste disposal site for waste generated in Texas. Since 1982, the Authority has been actively seeking a disposal site and evaluating disposal technologies. This activity has progressively narrowed and is now focused on three sites located in far west Texas. Coincident with this effort, the Authority has selected three technologies for analysis. For each of the three technologies, a conceptual design was prepared. From this design, cost estimates were prepared and an economic analysis was performed. In addition to this, a preliminary performance assessment was performed assuming that the facility was located at a referenced site in far West Texas. Based on the results of the study, the cost of all of the disposal methods is similar and approximately twice what a conventional shallow land burial facility would cost. All of the technologies will perform satisfactorily, assuming that the concrete structure perform as predicted. This is obviously critical for the above ground vault since the concrete provides the only barrier to radionuclide migration. For those technologies in which the waste is disposed of below grade, the durability of concrete is not as significant since the reference site would perform acceptably with conventional shallow land burial.

3006 (CONF-860990—Pt.4, pp 77-78) **Update on the activities of the central interstate low-level radioactive waste compact commission.** Peery, R.J. (Central Interstate Compact Commission, Atlanta, GA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Since its formation in 1983, the Central Interstate Low-Level Radioactive Waste Compact Commission has moved at a deliberate pace to meet the responsibilities placed on the states by federal law. In addition to the normal activities associated with an agency empowered to regulate a specific industry, the Commission has conducted a number of studies designed to help it meet its responsibilities. The Phase I Site Exclusionary Study identified those areas in each of the member states that failed to meet criteria set out in 10 CFR 61. The key elements of a Management Study are: an evaluation of the region's waste stream, development of the procedures the Commission will use to select a developer for the region's waste facility, an assessment of disposal alternatives, and the development of a plan to review the results of the management plan. The Commission is conducting a Phase II Site Exclusionary Study in which a closer analysis of each area will allow the Commission to determine if there are areas in each state that are capable of being sited. The Commission is also considering the draft Request for Proposals to Develop a Low-Level Radioactive Waste Facility within the Region.

3007 (CONF-860990—Pt.4, pp 79-82) **New York State low-level waste management strategy.** Dunkleberger, J.D. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The new state law is more than a siting law, it is a pretty complete management plan. It provides for siting, licensing and operation of a disposal facility, establishes authority and responsibility for specific actions, provides a funding mechanism for all these activities and a time line consistent with the federal law. The paper discusses what the law requires and what New York is doing to implement the law.

3008 (CONF-860990—Pt.4, pp 83-89) **Northern New England status.** Wight, A. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Recognizing the potential benefits of compact management, Massachusetts suggested in September 1985 that Maine, New Hampshire, Vermont and Rhode Island join with Massachusetts in an ad hoc effect to develop a common data base upon which potential future negotiation of a regional compact for low-level waste management could be initiated. Three subcommittees were formed: (1) decommissioning and decontamination; (2) risk sharing; and (3) compact language. After a year's discussion, the Decommissioning and Decontamination Report is finished; the Risk Sharing Group Report should be available by January, 1987; and the Compact Language Subcommittee has not met. The Decommissioning and Decontamination group's report is summarized here. 2 tables.

3009 (CONF-860990—Pt.4, pp 90-92) **California's story.** Hickman, J.H.; Womeldorf, D.J. (California Dept. of Health Services). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

California's production of low-level radioactive waste (LLRW) approximates 200,000 cubic feet/year. Three utilities operate 6 nuclear power plants at three sites; and there are some 2500 radioactive materials licensees, including medical, industrial, research, and educational users, many of which are also waste producers. While there is a wide geographic distribution within the state, most users are concentrated in the metropolitan areas of Southern California, the San Francisco Bay region and Sacramento and vicinity. The State has taken action in response the Low-Level Radioactive Waste Policy Act of 1980, the Low-Level Radioactive Waste Policy Amendments Act of 1985. The Legislature enacted laws in 1982 and 1983 which required California to provide its own site and which assigned specific responsibilities to the California Department of Health Services (DHS). Key charges to the DHS under the two pieces of legislation are listed. One task was to develop screening criteria for a LLRW disposal facility site. This paper describes DHS's efforts, the selection of US Ecology as a license designee, and the monitoring of the designee in the site selection process.

3010 (CONF-860990—Pt.4, pp 93-102) **Low-level radioactive waste: the Pennsylvania situation.** Krett, R.E.; Dornsife, W.P. (Pennsylvania Dept. of Environmental Resources, Harrisburg). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

In December 1985, the Pennsylvania legislature adopted and Governor Thornburgh signed into law the Appalachian States Low-Level Radioactive Waste Compact. The Appalachian Compact provides for the establishment and operation of facilities for regional disposal of low-level radioactive waste (LLRW) to eligible states. Pennsylvania is designated as the initial host state to develop a regional LLRW disposal facility. The Compact legislation did not grant Pennsylvania the authority to license, permit regulate, inspect or otherwise initiate the processes necessary to establish a LLRW disposal facility. The burden for implementing the Compact is placed on the state of Pennsylvania. The implementing legislation needed to proceed is currently in Pennsylvania's legislative process. Area Screening and Technology Performance/Design Criteria are currently being developed by D.E.R. staff in conjunction with a sixteen member public advisory committee. Upon enactment of the implementing legislation, Pennsylvania will proceed with all processes necessary to develop a regional LLRW disposal facility for the Appalachian Compact. 1 figure, 1 table.

3011 (CONF-860990—Pt.4, pp 4-19) **Siting a low-level radioactive waste incinerator in North Carolina: the impacts of public opposition.** Miller, E.M. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Establishing low-level radioactive waste (LLRW) facilities has become increasingly difficult due to public opposition to siting proposals. Widespread opposition to siting new waste management facilities of all types has focused sharp attention on the technical, political, and socioeconomic problems associated with siting controversial, but necessary facilities. This paper reviews a recent private sector initiative to site a LLRW incinerator in Bladen County, NC. Public reactions to the proposed facility are documents, as well as reasons for public opposition to the facility. The impacts of public opposition on the siting process, regulatory agencies, the media, industry, the general public, and elected officials are examined. The paper points out how public opposition to proposed waste management facilities may have both positive and negative impacts on the long-term management of LLRW. In doing so, the paper addresses policy questions, processes, and perceptions that will shape the debate over the development and location of new treatment and disposal facilities for managing LLRW. 14 references.

3012 (CONF-860990—Pt.4, pp 20-27) **Using compensation and incentives to site low-level radioactive waste facilities.** Schneider, P.; Rope, R.C. (ERM-McGlennon Associates, Boston, MA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This presentation discusses the basic principles behind the compensation and incentives approach and its incorporation in LLRW facility siting. The Midwest Compact experience is examined in detail along with several other state and compact approaches. An innovative siting simulation exercise with a strong incentive component is a also briefly discussed. Several states and compacts are now using the compensation and incentives approach to siting LLRW facilities. Surveys in Wisconsin and Pennsylvania suggest that these techniques can make a difference in public acceptance of such facilities. Other states are giving this approach serious consideration in developing their siting processes and regulations. There continues to be a reluctance to accept any form of payment for hosting an undesirable waste facility. If the compensation and incentives approach is to be successful, it must be clearly presented as an open and legitimate technique, not a sellout or buy off. It must be made clear that environmental and public health protection will not be jeopardized. Additional experience with the compensation and incentives approach to LLRW facility siting should demonstrate its effectiveness. 8 references, 1 table.

3013 (CONF-860990—Pt.4, pp 28-44) **Area screening in Pennsylvania.** Krett, R.E.; Dornsife, W.P. (Pennsylvania Dept. of Environmental Resources, Harrisburg). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Draft area screening criteria have been developed for use in the initial phase of the low-level radioactive waste disposal site selection process. They serve as both requirements and guidelines for evaluating the Commonwealth to delineate areas which have a high probability of containing potentially suitable sites for disposal of LLRW. The performance objectives are adopted from 10CFR61 and require protection of the general population and stability of the disposal facility. Overall requirements and disqualifying conditions

are established for screening categories. Potentially suitable areas are required to comply with each overall requirement and can have no disqualifying conditions present. Additional considerations are established which are not necessarily disqualifying but whose evaluations are considered important and necessary for potentially suitable areas to be considered qualified.

3014 (CONF-860990—Pt.5, pp 86-95) **ADGEN: a system for automated sensitivity analysis of predictive models.** Pin, F.G.; Horwedel, J.E.; Oblow, E.M.; Lucius, J.L. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A system that can automatically enhance computer codes with a sensitivity calculation capability is presented. With this new system, named ADGEN, rapid and cost-effective calculation of sensitivities can be performed in any FORTRAN code for all input data or parameters. The resulting sensitivities can be used in performance assessment studies related to licensing or interactions with the public to systematically and quantitatively prove the relative importance of each of the system parameters in calculating the final performance results. A general procedure calling for the systematic use of sensitivities in assessment studies is presented. The procedure can be used in modeling and model validation studies to avoid over modeling, in site characterization planning to avoid over collection of data, and in performance assessments to determine the uncertainties on the final calculated results. The added capability to formally perform the inverse problem, i.e., to determine the input data or parameters on which to focus to determine the input data or parameters on which to focus additional research or analysis effort in order to improve the uncertainty of the final results, is also discussed. 7 references, 2 figures.

3015 (CONF-860990—Pt.5, pp 96-106) **Summary: special waste form lysimeters - arid program.** Skaggs, R.L.; Walter, M.B. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The purpose of the Special Waste Form Lysimeters - Arid Program is to determine the performance of solidified commercial low-level waste forms using a field-scale lysimeter facility constructed for measuring the release and migration of radionuclides from the waste forms. The performance of these waste forms, as measured by radionuclide concentrations in lysimeter effluent, will be compared to that predicted by laboratory characterization of the waste forms. Waste forms being tested include nuclear power reactor waste streams that have been solidified in cement, Dow polymer, and bitumen. To conduct the field leaching experiments a lysimeter facility was built to measure leachate under actual environmental conditions. Field-scale samples of waste were buried in lysimeters equipped to measure water balance components, effluent radionuclide concentrations, and to a limited extent, radionuclide concentrations in lysimeter soil samples. The waste forms are being characterized by standard laboratory leach tests to obtain estimates of radionuclide release. These estimates will be compared to leach rates observed in the field. Adsorption studies are being conducted to determine the amount of contaminant available for transport after the release. Theoretical solubility calculations will also be performed to investigate whether common solid phases could be controlling radionuclide release. 4 references, 8 figures, 1 table.

3016 (CONF-860990—Pt.5, pp 107-116) **Performance of special wasteform lysimeters and waste migration at a humid site.** McIntyre, P.F. (Savannah River Lab., Aiken, SC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW. Contract AC09-76SR00001.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The special wasteform lysimeter (SWL) program at the Savannah River Laboratory (SRL) near Aiken, South Carolina is designed to measure leaching behavior and radionuclide migration under realistic burial conditions at a humid site. A similar program at an arid site is being conducted at Hanford near Richland, Washington. The wasteforms were placed in the lysimeters in March 1982 and represent typical low-level waste from two commercial reactors. An extensive report covering the initial three years of operation was issued in November 1985. This report updates the results of that report and includes significant observations made during the past year of operation. The Waste Migration Program at SRL included continued monitoring of 40 defense waste lysimeters, radionuclide uptake by pine trees, and measurement of total organic carbon in the ground water of the burial ground. 5 references, 2 figures, 5 tables.

3017 (CONF-860990—Pt.5, pp 117-119) **Experience and improved techniques in radiological environmental monitoring at major DOE low-level disposal sites.** Blanchfield, L.A.; Hedahl, T.G. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The primary purpose of this task was to provide a concise summary of routine radiological environmental surveillance programs conducted at major active US Department of Energy (DOE) solid low-level waste (LLW) disposal sites. The DOE disposal sites at which monitoring programs were reviewed included those located at Hanford, Idaho National Engineering Laboratory (INEL), Nevada Test Site (NTS), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL) and Savannah River Plant (SRP). A brief summary of routine monitoring programs at the active commercial LLW sites was also included in the task report. The draft task report was transmitted to all sites for review in June 1986.

3018 (CONF-860990—Pt.5, pp 1-9) **Process of performance assessment.** King, C.M.; Halford, D.K. (Savannah River Lab., Aiken, SC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Performance assessment is the process used to evaluate the environmental consequences of disposal of radioactive waste in the biosphere. An introductory review of the subject is presented. Emphasis is placed on the process of performance assessment from the standpoint of defining the process. Performance assessment, from evolving experience at DOE sites, has short-term and long-term subprograms, the components of which are discussed. The role of mathematical modeling in performance assessment is addressed including the pros and cons of current approaches. Finally, the system/site/technology issues as the focal point of this symposium are reviewed.

3019 (CONF-860990—Pt.5, pp 10-17) **Ramifications of defining high-level waste.** Wood, D.E.; Campbell, M.H.; Shupe, M.W. (Rockwell Hanford Operations, Richland, WA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Nuclear Regulatory Commission (NRC) is considering rule making to provide a concentration-based definition of high-level waste (HLW) under authority derived from the Nuclear Waste Policy Act (NWPA) of 1982 and the Low Level Waste Policy Amendments Act of 1985. The Department of Energy (DOE), which has the responsibility to dispose of certain kinds of commercial waste, is supporting development of a risk-based classification system by the Oak Ridge National Laboratory to assist in developing and implementing the NRC rule. The system is two dimensional, with the axes based on the phrases highly radioactive and requires permanent isolation in the definition of HLW in the NWPA. Defining HLW will reduce the ambiguity in the present source-based definition by providing concentration limits to establish which materials are to be called HLW. The system allows the possibility of greater-confinement disposal for some wastes which

do not require the degree of isolation provided by a repository. The definition of HLW will provide a firm basis for waste processing options which involve partitioning of waste into a high-activity stream for repository disposal, and a low-activity stream for disposal elsewhere. Several possible classification systems have been derived and the characteristics of each are discussed. The Defense High Level Waste Technology Lead Office at DOE - Richland Operations Office, supported by Rockwell Hanford Operations, has coordinated reviews of the ORNL work by a technical peer review group and other DOE offices. The reviews produced several recommendations and identified several issues to be addressed in the NRC rule making. 10 references, 3 figures.

3020 (CONF-860990—Pt.5, pp 18-22) **Waste-acceptance criteria for greater confinement disposal.** Gilbert, T.L.; Meshkov, N.K. (Argonne National Lab., IL). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A methodology for establishing waste-acceptance criteria based on quantitative performance factors that characterize the confinement capabilities of a waste disposal site and facility has been developed. The methodology starts from the basic objective of protecting public health and safety by providing assurance that disposal of the waste will not result in a radiation dose to any member of the general public, in either the short or long term, in excess of an established basic dose limit. The method is based on an explicit, straight-forward, and quantitative relationship among individual risk, confinement capabilities, and waste characteristics. A key aspect of the methodology is introduction of a confinement factor that characterizes the overall confinement capability of a particular facility and can be used for quantitative assessments of the performance of different disposal sites and facilities, as well as for establishing site-specific waste acceptance criteria. Confinement factors are derived by means of site-specific pathway analyses. They make possible a direct and simple conversion of a basic dose limit into waste-acceptance criteria, specified as concentration limits on radionuclides in the waste streams and expressed in quantitative form as a function of parameters that characterize the site, facility design, waste containers, and waste form. Waste acceptance criteria can be represented visually as activity/time plots for various waste streams. These plots show the concentrations of radionuclides in a waste stream as a function of time and permit a visual, quantitative assessment of long-term performance, relative risks from different radionuclides in the waste stream, and contributions from ingrowth. 13 references, 7 figures.

3021 (CONF-860990—Pt.5, pp 33-47) **Discriminating performance of disposal alternatives - can it be done.** Rogers, V.C.; Baird, R.D.; Murphy, E.S. (Rogers and Associates Engineering Corp., Salt Lake City, UT). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A basic principle of radioactive waste disposal is that the degree of isolation of the waste from human exposure should increase with the increase in the hazard of the waste. Most disposal concepts, including low-level waste disposal concepts, rely on isolation, limits on release rates, environmental retention, or environmental dilution to provide the necessary margin of safety. The answer to the question posed by the title of this paper is a qualified yes, depending on the measure of performance. Three methodologies for discriminating performance of low-level waste disposal alternatives are described. The disposal technology classification system distinguishes technologies on the basis of three qualitative performance functional features. These are relationship to natural grade, extent of cover, and presence and type of structure. Multiattribute utility estimation is a semiquantitative decision analysis methodology used to rank disposal alternatives by taking into account both the technical merit of a particular alternative and the relative importance of issues and factors used to make the technical judgment. Use of this decision methodology by several states and compacts to rank proposed near surface disposal alternatives is described. Multipathway performance assessment is a quantitative methodology that uses models to evaluate the abilities of different disposal technologies to limit the release of radioactivity to man and the environment. Unfortunately, the degree of sophistication of present models is such that discrimination between technologies is, generally, determined by differences in input parameters that are usually difficult to justify. Several examples of the use of pathway modeling are presented. 11 references, 2 figures, 5 tables.

3022 (CONF-860990—Pt.5, pp 48-59) **Development of a computerized data base for low-level waste leaching data.** Dougherty, D.R.; Colombo, P. (Brookhaven National Lab., Upton, NY). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A computerized data base (db) of low-level waste (LLW) leaching data is being compiled by Brookhaven National Laboratory under contract to the DOE Low-Level Waste Management Program. Although this db is being compiled as part of an effort to develop accelerated leach test procedures for LLW forms, other involved in LLW management may find it useful. The db is implemented on an IBM PC XT and is self-contained in that its data manipulation and analysis programs are not proprietary (i.e., need not be purchased). The db includes data from the Accelerated Leach Test(s) Program plus selected literature data, which have been selected based on criteria that include completeness of the experimental description and elucidation of leaching mechanisms. 6 references, 5 figures, 3 tables.

3023 (CONF-860990—Pt.5, pp 60-74) **Radionuclide migration in ground water at a low-level waste disposal site: a comparison of predicted radionuclide transport modeling versus field observations.** Bergeron, M.P.; Robertson, D.E.; Champ, D.R.; Killey, R.W.D.; Moltyaner, G.L. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

At the Chalk River Nuclear Laboratories (CRNL), in Ontario, Canada, a number of LLW shallow-land burial facilities have existed for 25-30 years. These facilities are useful for testing the concept of site modelability. In 1984, CRNL and the Pacific Northwest Laboratory (PNL) established a cooperative research program to examine two disposal sites having plumes of slightly contaminated ground water for study. This report addresses the LLW Nitrate Disposal Pit site, which received liquid wastes containing approximately 1000-1500 curies of mixed fission products during 1953-54. The objective of this study is to test the regulatory requirement that a site be modeled and to use the Nitrate Disposal Pit site as a field site for testing the reliability of models in predicting radionuclide movement in ground water. The study plan was to approach this site as though it were to be licensed under the requirements of 10 CFR 61. Under the assumption that little was known about this site, a characterization plan was prepared describing the geologic, hydrologic, and geochemical information needed to assess site performance. After completion of the plan, site data generated by CRNL were selected to fill the plan data requirements. This paper describes the site hydrogeology, modeling of ground water flow, the comparison of observed and predicted radionuclide movement, and summarizes the conclusions and recommendations. 3 references, 10 figures.

3024 (CONF-860990—Pt.5, pp 75-85) **Failure analysis of engineered barriers used in alternatives to shallow land burial.** Otis, M.D. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012446/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A study has been completed which evaluates the relative importance of various engineered barriers used in enhancements and alternatives to traditional shallow land burial. The analysis ranks the contribution of various components to the performance of each disposal system by examining the failure of all possible combina-

tions of components. Ten near surface disposal systems are considered. They include variations of five alternatives: shallow land burial, earth mounded tumuli, above ground vaults, below ground vaults, and augered shafts. These designs incorporate four types of engineered barriers in several combinations: earthen covers, concrete structures, fill materials, and enhanced containers. This analysis is the first in a series of studies on safety aspects of alternative disposal technologies which will provide technical information to support performance assessments for these alternatives. This work has been sponsored by the Office of Nuclear Regulatory Research, USNRC. 5 tables.

3025 (CONF-860990—Pt.6, pp 2-16) **Solidification of DOE problem wastes.** Franz, E.M.; Heiser, J.H. III; Colombo, P. (Brookhaven National Lab., Upton, NY). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Sodium nitrate waste has been successfully solidified in two types of polymeric materials: polyethylene, a thermoplastic material, and polyester styrene (PES), a thermosetting material. waste form property evaluation tests such as ANS 16.1 leaching test and compressive strength measurements were performed on the waste forms containing various amounts of sodium nitrate. A single-screw extruder was employed for incorporating dry waste into polyethylene at its melt temperature of 120 C to produce a homogeneous mixture. Results of the leaching test for polyethylene waste forms containing 30, 50, 60 and 70 wt% sodium nitrate are presented as cumulative fraction leached and leaching indices ranging from 11 to 7.8. Two PES systems are discussed. The first is for solidification of dry salt wastes and the second is a water extendible system that is compatible with wet waste streams. Leaching data for PES and water extendible PES waste forms containing 30 wt% sodium nitrate are presented as cumulative fraction leached and leaching indices of approximately 9. Results from compressive strength measurements are also included. 7 references, 7 figures, 6 tables.

3026 (CONF-860990—Pt.6, pp 17-26) **EPRI waste processing projects.** Shaw, R.A. (Electric Power Research Institute, Palo Alto, CA). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Electric Power Research Institute (EPRI) manages research for its sponsoring electric utilities in the United States. Research in the area of low level radioactive waste (LLRW) from light water reactors focuses primarily on waste processing within the nuclear power plants, monitoring of the waste packages, and assessments of disposal technologies. Accompanying these areas and complimentary to them is the determination and evaluation of the sources of nuclear power plants radioactive waste. This paper focuses on source characterization of nuclear power plant waste, LLRW processing within nuclear power plants, and the monitoring of these wastes. EPRI's work in waste disposal technology is described in another paper in this proceeding by the same author. 1 reference, 5 figures.

3027 (CONF-860990—Pt.6, pp 27-35) **Low-level waste incineration: experience at the Idaho National Engineering Laboratory.** Bohrer, H.A.; Dalton, J.D. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Waste Experimental Reduction Facility (WERF) is a low level radioactive waste treatment facility being operated at the Idaho National Engineering Laboratory (INEL). A key component of the facility is a dual chambered controlled air incinerator with a dry off-gas treatment system. The incinerator began processing radioactive waste in September, 1984. Limited operations continued from that data until October, 1985, at which time all INEL generators began shipping combustible waste for incineration. The incinerator is presently processing all available INEL combustible Dry Active Waste (DAW) (approximately 1700 m^3 per year) operating about five days per month. Performance to date has demonstrated the effectiveness, viability and safety of incineration as a volume reduction method of DAW. 3 figures.

3028 (CONF-860990—Pt.6, pp 36-50) **Waste management systems model for energy systems sites on the Oak Ridge Reservation.** Rodgers, B.R.; Nehls, J.W. Jr.; Rivera, A.L.; Pechin, W.H.; Genung, R.K. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Oak Ridge Model (ORM) is a DOE/Oak Ridge Operations (DOE/ORO) initiative which involves regulators and the public at the problem definition stage to attempt to reach a consensus on acceptable approaches to the solution of waste management problems. Once the approaches have been defined, the private sector participates in identifying and demonstrating the technologies to be employed. The Waste Management Systems Model (WSM), a major part of the ORM, is discussed in this paper. It can be generically described as employing a number of computer models to: 1. determine waste management requirements (e.g., capabilities and capacities); 2. develop scenarios that respond to changes in requirements and that evaluate alternatives as they become available; 3. compare these scenarios technically, operationally, and financially; and 4. select the most promising technologies for demonstration. 12 figures.

3029 (CONF-860990—Pt.6, pp 51-63) **Low-level waste treatment at the West Valley demonstration project.** Maestas, E.; Spaunburgh, R.G.; Leap, D.R. (Dept. of Energy, Washington, DC). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The West Valley Demonstration Project, mandated by Public Law 96-368, directed the United States Department of Energy (DOE) to solidify 580,000 gallons of high-level radioactive waste generated at a former nuclear fuel reprocessing plant and decontaminate and decommission the facilities used in support of the solidification program. Low-level waste generated as part of the Project will be treated and disposed of onsite. A quality control and assurance program is planned to assure compliance with the applicable portions of 10 CFR 61 and DOE Order 5820.2. This paper describes the unique characteristics of the West Valley waste streams, the methods of liquid waste treatment for volume reduction and subsequent solidification by cement, TRU decon, size reduction of equipment using both contact and remote handling, and compaction techniques. 3 references, 3 figures, 2 tables.

3030 (CONF-860990—Pt.6, pp 64-68) **INEL waste reduction: summary paper.** Rhoades, W.A. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Idaho National Engineering Laboratory (INEL) is a Department of Energy (DOE) facility located in southeastern Idaho. Located at the INEL are a Waste Experimental Reduction Facility (WERF) which processes low level radioactive waste (LLW) materials and a Radioactive Waste Management Complex (RWMC) which provides for disposal of radioactive waste materials. There are currently 9 active facilities (waste generators) at the INEL which produce an average total volume of about 5000 cubic meters of solid LLW annually. This boxed or bulk waste is ultimately disposed of at the RWMC Subsurface Disposal Area (SDA). The SDA is currently the only active LLW disposal site at the INEL, and the prospects for opening another shallow land burial disposal facility are uncertain. Therefore, it has become imperative that EG & G Idaho Waste Management Department make every reasonable effort to extend the disposal life of the SDA. Among Waste Management Department's principal efforts to extend the SDA disposal life are operation of the Waste Experimental Reduction Facility (WERF) and administration of the

INEL Waste Reduction Program. The INEL Waste Reduction Program is charged with providing assistance to all INEL facilities in reducing LLW generation rates to the lowest practical levels while at the same time encouraging optimum utilization of the volume reduction capabilities of WERF. Both waste volume and waste generation reductions are discussed.

3031 (CONF-860990—Pt.6, pp 69-73) **Waste characterization practices: summary paper.** Logan, J.A. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Recent reviews of the records on disposal waste at several DOE sites have indicated that records still contain little information practical to waste management. Much of the disposed waste is identified by vague terms, i.e., general plant waste. Attached to this paper is a new waste characterization code devised by the Idaho National Engineering Laboratory to aid in waste volume reduction and stabil ation. It is recommended that every facility involved in waste generation and disposal needs to be detailing its wastes to support upgrading of waste management practices. 1 table.

3032 (CONF-860990—Pt.6, pp 74-76) **Stabilization of mixed waste at INEL: summary paper.** Boehmer, A.M.; Gillins, R.L.; Larsen, M.M. Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

There is one category of low-level radioactive waste (LLRW) which cannot be disposed of at the Idaho National Engineering Laboratory (INEL). LLRW, which is also hazardous [as defined by the Resource Conservation and Recovery Act (RCRA) in 40 CFR 261], is considered a radioactive mixed waste (RMW). The Department of Energy - Idaho Operations Office has decided that the Radioactive Waste Management Complex (RWMC), which is the INEL's LLRW disposal facility, shall not accept RMW. Proper disposition of a hazardous waste (HW) requires that the HW be sent to an Environmental Protection Agency (EPA) permitted disposal facility. Existing EPA-permitted disposal facilities will not accept radioactively contaminated hazardous waste since they do not have an NRC license and are not designed to handle radioactivity. There are two other options for dealing with RMW: to treat is so that it is no longer hazardous or radioactive, or to store it until it can be treated or legally disposed of. Treatment and storage of a RMW also requires an EPA permit. The INEL has applied to the EPA for a RCRA Part B permit. The permit application includes a storage facility for HW, a storage facility for RMW, incineration of HW and RMW, and stabilization of HW and RMW. This paper describes the stabilization development activities conducted at the INEL by EG & G Idaho, Inc., for the DOE.

3033 (CONF-860990—Pt.6, pp 77-80) **Greater confinement disposal and saltstone waste disposal technology.** Sturm, H.F. Jr.; Stone, J.A. (Savannah River Lab., Aiken, SC). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012447/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A Greater Confinement Disposal (GCD) demonstration facility consisting of 20 GCD boreholes, for solid, low-level radioactive waste, has been in operation at the Savannah River Plant since 1984. Construction of a Greater Confinement Disposal trench will be completed in late 1986. Low-Level waste salt solution, separated from high-level nuclear waste by a process combining precipitation, adsorption, and filtration, will be mixed with a cement-fly ash blend to form saltstone. The saltstone will be disposed of onsite in an engineered disposal area. Based on mathematical predictions, the saltstone disposal area is designed to meet or exceed ground water standards for all potential contaminants. 5 references, 2 figures.

3034 (CONF-860990—Pt.7, pp 6-18) **EPA's criteria development for radioactive waste that is Below Regulatory Concern.** Holcomb, W.F.; Gruhlke, J.M. (Environmental Protection Agency). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The EPA's program for developing environmental standards for land disposal of low-level radioactive wastes, including a criterion for determining wastes with sufficiently low levels of radioactivity to be considered Below Regulatory Concern (BRC) has completed its risk assessment and cost-effectiveness analyses. The analyses for the BRC criterion included evaluation of general population health risks, maximum annual exposures to critical population groups, and costs of risk reduction. These risk assessments include analyses of 18 surrogate radioactive waste streams, representing both fuel cycle and non-fuel cycle facilities. Less restrictive disposal alternatives typical of those used for municipal garbage disposal, such as sanitary landfills, and situated in diverse demographic settings were used in the analyses. A number of waste types which contribute only small doses or fractions of a health effect over 10,000 years from unregulated disposal were identified. Disposal of such wastes without consideration of their very low radioactivity content results in significant cost savings. 3 references, 1 figure, 4 tables.

3035 (CONF-860990—Pt.7, pp 19-39) **Results of interagency effort to determine carbon-14 source term in low-level radioactive waste.** Gruhlke, J.M.; Meyer, G.L.; Neiheisel, J. (Environmental Protection Agency). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A preliminary estimate of the risks from the shallow land disposal of low-level radioactive wastes by EPA in 1984-1985 indicated that Carbon-14 caused virtually all of the risk and that these risks were relatively high. Therefore, an informal interagency group, which included the US Department of Energy, US Geological Survey, US Nuclear Regulatory Commission, and US Environmental Protection Agency, formed in 1985 to obtain up-to-date information on the activity and chemical form of Carbon-14 in the different types of LLW and how Carbon-14 behaves after disposal. The EPA acted as a focal point for collating the information collected by all of the Agencies and will publish a report in Fall 1986 on the results of the Carbon-14 data collection effort. Of particular importance, the study showed that Carbon-14 activity in LLW was overestimated approximately 2000%. This paper summarizes results of the Carbon-14 data collection effort. 40 references, 1 figure, 3 tables.

3036 (CONF-860990—Pt.7, pp 40-46) **Overview of the mixed low-level radioactive waste issue.** Bahadur, S. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Under the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency (EPA) has jurisdiction over the disposal of solid wastes with the exception of source, byproduct, and special nuclear material, which are regulated by the Nuclear Regulatory Commission (NRC) under the Atomic Energy Act (AEA). These low-level hazardous wastes (LLW) can also contain chemical constituents which are hazardous under EPA regulations 40 CFR Part 261. Such wastes are commonly referred to as Mixed Low-Level Radioactive and Hazardous Waste (Mixed LLW). NRC regulations exist to control the byproduct, source, and special nuclear material components of the Mixed LLW; EPA has the authority and continues to develop regulations to control the hazardous component of the Mixed LLW. Thus, all of the individual constituents of Mixed LLW are subject to either NRC or EPA regulations. However, when the components are combined to become Mixed LLW, neither agency has exclusive ju-

risdiction. This has led to a situation of dual regulation where both agencies, NRC and EPA, regulate the same waste. This paper discusses the jurisdiction issue, NRC's efforts to date, and NRC's present approach to develop guidance to reduce the volume of mixed LLW and to develop alternatives concerning statutory and regulatory differences affecting mixed LLW disposal. 6 references.

3037 (CONF-860990—Pt.7, pp 47-60) **Potential for deregulated disposal of very low level wastes from nuclear power plants.** Davis, J.P.; Chan, D.W. (General Physics Corp.). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The purpose of the study discussed in this paper was to review the characteristics of low level waste streams generated in commercial nuclear power facilities to determine which may be suitable for disposal by methods other than transfer to a facility licensed by the Nuclear Regulatory Commission (NRC) and to evaluate the benefits, risks, and costs of exempting such very low level wastes (VLW) from the disposal requirements of 10 CFR Part 61. Of course, wastes that no longer require regulation of their radiological properties are still subject to the regulatory controls - federal, state, or local - that affect non-radioactive wastes of similar chemical and physical properties and similar origins. This study addressed radiological aspects only, and assumed, in its evaluations, that the wastes can and will be disposed of in accordance with all other applicable requirements. 4 references, 1 figure, 6 tables.

3038 (CONF-860990—Pt.7, pp 61-72) **Inclusion of NARM in the EPA LLW standard.** Bandrowski, M.S.; Gruhlke, J.M. (Environmental Protection Agency). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Environmental Protection Agency (EPA) received numerous comments that naturally occurring and accelerator-produced radioactive materials (NARM) should be covered in the development of the Agency's environmental standards for the disposal of low-level radioactive waste (LLW). EPA commissioned a study to characterize NARM wastes and subsequently analyzed the risks from the disposal of such wastes using the PRESTO-EPA and PATHRAE computer codes. Eight candidate NARM waste streams were analyzed for regulation under the EPA LLW standards. Based on considerations of health risk, comparability with Atomic Energy Act regulated materials and disposal practices, and cost-benefit analyses, two higher activity, small volume waste streams were selected for inclusion. This paper summarizes the results of the characterization and cost-benefit analysis, and outlines EPA's reasons for regulating these NARM wastes. The regulatory framework for including NARM wastes and the form of the rule is also discussed. 8 references, 4 tables.

3039 (CONF-860990—Pt.7, pp 73-83) **Summary of DOE threshold limits efforts.** Wickham, L.E.; Smith, C.F.; Cohen, J.J. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The Department of Energy (DOE) has been developing the concept of threshold quantities for use in determining which waste materials may be disposed of as nonradioactive waste in DOE sanitary landfills. Waste above a threshold level could be managed as radioactive or mixed waste (if hazardous chemicals are present); waste below this level would be handled as sanitary waste. After extensive review of a draft threshold guidance document in 1985, a second draft threshold background document was produced in March 1986. The second draft included a preliminary cost-benefit analysis and quality assurance considerations. The review of the second draft has been completed. Final changes to be incorporated include an in-depth cost-benefit analysis of two example sites and recommendations of how to further pursue (i.e. employ) the concept of threshold quantities within the DOE. 3 references.

3040 (CONF-860990—Pt.7, pp 84-92) **Cost effectiveness of below-threshold waste disposal at DOE sites.** Smith, C.F.; Cohen, J.J. (Science Applications International Corp.). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

A minimal health and environmental risk, limitations on disposal capacity, and the relatively high costs of low level waste (LLW) disposal are basic driving forces that lead to consideration of less restrictive disposal of wastes with very low levels of radiological contamination. The term threshold limit describes radioactive wastes that have sufficiently low-levels of radiological content to be managed according to their nonradiological properties. Given the efforts described elsewhere to provide guidance on the definition of below threshold (BT) doses and concentration levels, the purpose of this study was to quantify the resultant quantities, costs and cost effectiveness of BT disposal. For purposes of consistency with the previous demonstrations of the application of the threshold concept, available data for waste streams at the Idaho National Engineering Laboratory (INEL) and the Savannah River Plant (SRP) sites were collected and analyzed with regard to volumes, radionuclide concentrations, and disposal costs. From this information, quantities of BT waste, potential cost savings and cost effectiveness values were estimated. 1 reference, 5 tables.

3041 (CONF-860990—Pt.7, pp 93-100) **Defining mixed low-level radioactive and hazardous waste.** Weber, M.F. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

During the last several months, staffs of the US Nuclear Regulatory Commission (NRC) and the US Environmental Protection Agency (EPA) have been developing a working definition of Mixed Low-Level Radioactive and Hazardous Waste (Mixed LLW). Such wastes are currently being regulated by NRC under authority of the Atomic Energy Act (AEA), as amended, and by EPA under the Resource Conservation and Recovery Act (RCRA), as amended. Development of the definition is one component of a comprehensive program to resolve differences between the regulatory programs of the two agencies pertaining to the regulation of the management and disposal of Mixed LLW. Although the definition is still undergoing legal and policy reviews in both agencies, this paper presents the current working definition, discusses a methodology that may be used by NRC licensees to identify Mixed LLW, and provides responses to anticipated questions from licensees about the definition. 3 references, 1 figure.

3042 (CONF-860990—Pt.7, pp 101-108) **Summary of BNL studies regarding commercial mixed waste.** Bowerman, B.S.; Kempf, C.R.; MacKenzie, D.R.; Siskind, B.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY). Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

The disposal of low-level radioactive waste (LLW) is regulated by the US Nuclear Regulatory Commission (NRC) under 10 CFR Part 61. Concerns have emerged regarding the applicability of US Environmental Protection Agency (EPA) regulations and permit requirements, under the Resource Conservation and Recovery Act, to the potentially hazardous chemical content of some LLW, and the appropriate methods for managing such wastes. In order to establish a data base on their quantities and characteristics, Brookhaven National Laboratory (BNL) reviewed the literature and conducted a limited survey of reactor and non-reactor waste generators. Based on these studies, low-level wastes which are potentially hazardous under EPA regulations have been identified. A subsequent study included a technical evaluation of treatment options for managing these potential mixed wastes. Management options have been evaluated for their potential to address both NRC

and EPA concerns. They include regulatory or administrative actions as well as treatment or handling methods. 7 references, 1 table.

3043 (CONF-860990—Pt.8, pp 1-4) **DOE systems approach and integration.** Logan, J.A. Feb 1987. NTIS, PC A03/MF A01. Order Number DE87012449/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Six sites are now disposing of most of DOE's currently generated waste. These are: Hanford, Idaho National Engineering Laboratory, Los Alamos National Laboratory, the Nevada Test Site, Oak Ridge, and Savannah River. Within DOE, experience with disposal of solid LLW has been that arid site disposal facilities (first four) appear to have performed well, while humid site disposal facilities (last two) have experienced some waste migration. DOE's intent, of course, is to operate all its waste disposal facilities so that public health and safety are not adversely affected. To ensure that this continues to be the case, activities are underway to increase use of waste form stabilization and engineered barriers where appropriate. For the sake of overall economy, these measures are to be applied as and where needed, through use of the systems approach. In this paper the author discusses two topics: the system approach, which DOE has decided to use for resolving waste disposal problems in the management of DOE's low-level wastes; and DOE's intended integration of activities underway at the waste management systems throughout DOE facilities. 2 figures.

3044 (CONF-860990—Pt.8, pp 5-13) **Impacts of hazardous waste regulation on low-level waste management.** Sharples, F.E.; Eyman, L.D. Feb 1987. NTIS, PC A03/MF A01. Order Number DE87012449/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Since passage of the 1984 amendments to the Resource Conservation and Recovery Act (RCRA), major changes have occurred in the regulation of hazardous waste. The US Environmental Protection Agency (EPA) has also greatly modified its interpretation of how these regulations apply to wastes from federal facilities, including defense wastes from US Department of Energy (DOE) sites. As a result, the regulatory distinctions between low-level radioactive waste (LLW) and hazardous waste are becoming blurred. This paper discusses recent statutory and regulatory changes and how they might affect the management of LLW at DOE facilities. 6 references.

3045 (CONF-860990—Pt.8, pp 19-36) **Establishment of new disposal capacity for the Savannah River Plant.** Albenesius, E.L.; Wilhite, E.L. (Savannah River Lab., Aiken, SC). Feb 1987. NTIS, PC A03/MF A01. Order Number DE87012449/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Two new low-level waste (LLW) disposal sites for decontaminated salt solidified with cement and fly ash (saltstone) and for conventional solid LLW are planned for SRP in the next several years. An above-ground vault disposal system for saltstone was designed to minimize impact on the environment by controlling permeability and diffusivity of the waste form and concrete liner. The experimental program leading to the engineered disposal system included formulation studies, multiple approaches to measurement of permeability and diffusivity, extensive mathematical modeling, and large-scale lysimeter tests to validate model projections. The overall study is an example of the systems approach to disposal site design to achieve a predetermined performance objective. The same systems approach is being used to develop alternative designs for disposal of conventional LLW at the Savannah River Plant. 14 figures.

3046 (CONF-870859—19) **Sensitivity analysis of predictive models with an automated adjoint generator.** Pin, F.G.; Oblow, E.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000576/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The adjoint method is a well established sensitivity analysis methodology that is particularly efficient in large-scale modeling problems. The coefficients of sensitivity of a given response with respect to every parameter involved in the modeling code can be calculated from the solution of a single adjoint run of the code. Sensitivity coefficients provide a quantitative measure of the importance of the model data in calculating the final results. The major drawback of the adjoint method is the requirement for calculations of very large numbers of partial derivatives to set up the adjoint equations of the model. ADGEN is a software system that has been designed to eliminate this drawback and automatically implement the adjoint formulation in computer codes. The ADGEN system will be described and its use for improving performance assessments and predictive simulations will be discussed. 8 refs., 1 fig.

3047 (CONF-870859—21) **Characterization of waste streams on the Oak Ridge Reservation.** Rivera, A.L.; Osborne-Lee, I.W.; Jackson, A.M.; Butcher, B.T. Jr.; Van Cleve, J.E. Jr. (Oak Ridge National Lab., TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA); Oak Ridge Y-12 Plant, TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000578/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Oak Ridge Reservation (ORR) plants generate solid low-level waste (LLW) that must be disposed of or stored on-site. The available disposal capacity of the current sites is projected to be fully utilized during the next decade. An LLW disposal strategy has been developed by the Low-Level Waste Disposal Development and Demonstration (LLWDDD) Program as a framework for bringing new, regulator-approved disposal capacity to the ORR. An increasing level of waste stream characterization will be needed to maintain the ability to effectively manage solid LLW by the facilities on the ORR under the new regulatory scenario. In this paper, current practices for solid LLW stream characterization, segregation, and certification are described. In addition, the waste stream characterization requirements for segregation and certification under the LLWDDD Program strategy are also examined. 6 refs., 3 figs., 4 tabs.

3048 (CONF-870971—3) **Deterministic methods for sensitivity and uncertainty analysis in large-scale computer models.** Worley, B.A.; Oblow, E.M.; Pin, F.G.; Maerker, R.E.; Horwedel, J.E.; Wright, R.Q.; Lucius, J.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000585/JAW.

From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA (15 Sep 1987).

The fields of sensitivity and uncertainty analysis are dominated by statistical techniques when large-scale modeling codes are being analyzed. This paper reports on the development and availability of two systems, GRESS and ADGEN, that make use of computer calculus compilers to automate the implementation of deterministic sensitivity analysis capability into existing computer models. This automation removes the traditional limitation of deterministic sensitivity methods. The paper describes a deterministic uncertainty analysis method (DUA) that uses derivative information as a basis to propagate parameter probability distributions to obtain result probability distributions. The paper demonstrates the deterministic approach to sensitivity and uncertainty analysis as applied to a sample problem that models the flow of water through a borehole. The sample problem is used as a basis to compare the cumulative distribution function of the flow rate as calculated by the standard statistical methods and the DUA method. The DUA method gives a more accurate result based upon only two model executions compared to fifty executions in the statistical case.

3049 **(CONF-871075—9) Waste Examination Assay Facility operations: TRU waste certification.** Schultz, F.J.; Caylor, B.A.; Coffey, D.E.; Phoenix, L.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000948/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The ORNL Waste Examination Assay Facility (WEAF) was established to nondestructively assay (NDA) transuranic (TRU) waste generated at Oak Ridge National Laboratory (ORNL). The present facility charter encompasses the NDA and nondestructive examination (NDE) of both TRU and low-level wastes (LLW). Presently, equipment includes a Neutron Assay System (NAS), a Segmented Gamma Scanner (SGS), a drum-sized Real-Time Radiography (RTR) system, and a Neutron Slab Detector (NSD). The first three instruments are computer interfaced. Approximately 2300 TRU waste drums have been assayed with the NAS and the SGS. Another 3000 TRU and LLW drums have been examined with the RTR unit. Computer data bases have been developed to collate the large amount of data generated during the assays and examinations. 6 refs., 1 tab.

3050 **(CONF-871124—2) Immobilization of technetium and nitrate in cement-based materials.** Tallent, O.K.; McDaniel, E.W.; Del Cul, G.D.; Dodson, K.E.; Trotter, D.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000345/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The leachabilities of technetium and nitrate wastes immobilized in cement-based grouts have been investigated. Factors found to affect the leachabilities include grout mix ratio, grout fluid density, dry solid blend composition, and waste concentration. 10 refs., 7 figs., 3 tabs.

3051 **(DOE/CH/10140—03-87-1) Salt Repository Project: Technical progress report for the quarter, 1 October-31 December 1986.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1986. Contract AC02-83CH10140. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87014300/JAW.

This document reports progress being made on the development of a geologic repository in salt for the permanent disposal of high-level nuclear waste. Reporting elements are arranged by the work breakdown structure so that related studies are presented together. 6 refs., 3 figs.

3052 **(DOE/LLW—60T) Alternative concepts for Low-Level Radioactive Waste Disposal: Conceptual design report.** (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Jun 1987. Contract AC07-76ID01570. 775p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE87014889/JAW.

This conceptual design report is provided by the Department of Energy's Nuclear Energy Low-Level Waste Management Program to assist states and compact regions in developing new low-level radioactive waste (LLW) disposal facilities in accordance with the Low-Level Radioactive Waste Policy Amendment Act of 1985. The report provides conceptual designs and evaluations of six widely considered concepts for LLW disposal. These are shallow land disposal (SLD), intermediate depth disposal (IDD), below-ground vaults (BGV), above-ground vaults (AGV), modular concrete canister disposal (MCCD), earth-mounded concrete bunker (EMCB). 40 refs., 45 figs., 77 tabs.

3053 **(DOE/NE—0081) 1986 Annual report on Low-Level Radioactive Waste Management progress.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Jun 1987. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000671/JAW.

This report summarizes the progress of states and compact regions without low-level waste disposal sites (non-sited compact regions and nonmember states) in 1986 in siting new low-level waste disposal facilities. It also reports the volume of low-level waste received for disposal in 1986 by commercially operated low-level waste disposal facilities. 6 figs., 7 tabs.

3054 **(DOE/NE/44348—1) The Michigan high-level radioactive waste program: Final technical progress report.** (Michigan Dept. of Public Health, Lansing (USA)). 24 Jul 1987. Contract FG02-83NE44348. 94p. NTIS, PC A05. Order Number DE87013909/JAW.

This report comprises the state of Michigan's final technical report on the location of a proposed high-level radioactive waste disposal site. Included are a list of Michigan's efforts to review the DOE proposal and a detailed report on the application of geographic information systems analysis techniques to the review process. (TEM)

3055 **(DOE/NV/10322—18) NNWSI [Nevada Nuclear Waste Storage Investigations] hole histories, USW H-1, USW H-3, USW H-4, USW H-5, USW H-6.** (Fenix and Scisson, Inc., Tulsa, OK (USA); Fenix and Scisson, Inc., Mercury, NV (USA)). Jun 1987. Contract AC08-84NV10322. 99p. NTIS, PC E17/MF $36.35; GPO Dep. Order Number DE88000301/JAW.

Includes 81 sheets of 24X reduction microfiche.

This report is a compilation of data from five boreholes drilled within the Bureau of Land Management (BLM) lands adjacent to the Nevada Test Site (NTS). The boreholes were drilled to obtain hydrologic, geologic, and geophysical data. Information presented includes locations, daily activities, reviews of hole condition, geophysical log listings, video tape listings, and microfiche copies of all geophysical logs.

3056 **(DOE/NV/10322—20) NNWSI [Nevada Nuclear Waste Storage Investigations] hole histories, USW UZ-1, UE-25 UZ No. 4, UE-25 UZ No. 5, USW UZ-6, USW UZ-6s, USW UZ-7, USW UZ-8, USW UZ-13.** (Fenix and Scisson, Inc., Mercury, NV (USA)). Apr 1987. Contract AC08-84NV10322. 83p. NTIS, PC E07/MF $7.95; GPO Dep. Order Number DE88000302/JAW.

Includes 11 sheets of 24x reduction microfiche.

This report is a compilation of data from eight exploratory boreholes drilled to help characterize the geology and hydrology of the unsaturated zone. The eight holes were drilled in Area 25 of the Nevada Test Site and in Bureau of Land Management land adjacent to the Nevada Test Site. Data presented in the hole histories include all locations, daily activities, review of hole conditions, geophysical log lists and microfiche copies of the geophysical logs.

3057 **(DOE/NV/10322—21) NNWSI [Nevada Nuclear Waste Storage Investigations] hole histories: Unsaturated zone-neutron holes: 76 boreholes drilled between May 1984 and February 1986.** (Fenix and Scisson, Inc., Mercury, NV (USA)). May 1987. Contract AC08-84NV10322. 311p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88000777/JAW.

This is a compilation of data from seventy-four shallow alluvial exploratory core holes and two shallow calibration core holes. The boreholes were drilled to obtain undisturbed alluvial cores, to determine vertical distribution of moisture content and water potential, and to run neutron moisture logs. Data presented in the hole histories include all locations, daily activities and review of hole conditions.

3058 **(DOE/NV/10322—24) NNWSI [Nevada Nuclear Waste Storage Investigations] drilling and mining summary.** (Fenix and Scisson, Inc., Mercury, NV (USA)). Jul 1987. Contract AC08-84NV10322. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000778/JAW.

This is a summary report for all boreholes drilled prior to July 1, 1987, in support of the Nevada Nuclear Waste Storage Investigation (NNWSI). The boreholes were drilled in Areas 1, 5, 16, 17, 25, 26, 29, and 30 of the Nevada Test Site and in Bureau of Land Management land adjacent to the Nevada Test Site. The report contains the borehole designation, As-Built or Lay-Out (L/O) coordinates, ground level elevation, REECo work order number, casting depths and diameters, drill hole depths and diame-

ters, spud and completion dates, and pertinent remarks for all NNWSI and related boreholes. The report gives the DOE report number from which detailed information can be obtained for each borehole.

3059 **(DOE/RW—0101-Rev.1) Office of Geologic Repositories issues hierarchy for a mined geologic disposal system .** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Aug 1987. 26p. (OGR/B—10). Office of Civilian Radioactive Waste Management, USDOE, RW-40, Washington, DC 20585. Order Number DE88000251/JAW.

The Nuclear Regulatory Commission (NRC) has indicated that the identification of the issues that must be resolved to complete licensing assessments of site and design suitability is an important step in the licensing process. The issues hierarchy developed by the Office of Geologic Repositories (OGR) for the mined geologic disposal system (MGDS) are based on the issues-hierarchy concept presented in the Mission Plan. Specific questions are encompassed by the general issue statements in the OGR issues hierarchy. The OGR issues hierarchy is limited to the issues related to the siting and licensing requirements of applicable federal regulations and does not address the requirements of other regulations, functional or operating requirements for the MGDS, or requirements for the integration and the design/operational efficiency of the MGDS. 4 figs.

3060 **(DOE/RW—0145) Quarterly report on program cost and schedule: Second quarter, FY 1987.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). 1987. 40p. Office of Civilian Radioactive Waste Management, USDOE, RW-40, Washington, DC 20585. Order Number TI87014595/JAW.

This report provides a summary of the cost and schedule performance for the civilian radioactive waste management program. Performance data are presented for each of the major program elements. Also included is the status of the Nuclear Waste Fund revenues and disbursements. 19 figs.

3061 **(DOE/RW—0146) Office of Civilian Radioactive Waste Management: Annual capacity report.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 86p. Office of Civilian Radioactive Waste Management, USDOE, RW-40, Washington, DC 20585. Order Number TI87013095/JAW.

The system configuration used as the basis for this report is defined in the Mission Plan Amendment. It includes a Monitored Retrievable Storage (MRS) facility as an integral system component. During the first 10 years of WMS operation, the total quantity of spent fuel that could be accepted is 18,600 metric tons uranium (MTU). By starting WMS operations in 1998, the MRS facility could accept 6000 MTU of spent fuel by the time repository operations are projected to begin in 2003. The allocation of acceptance right is currently based on the projected annual capacity of the waste management system to receive SNF and the age of permanently discharged spent fuel. The allocations are based on the oldest fuel having the highest priority. Section 1.0 provides a discussion of the requirement for the (ACR) and the role the ACR will play in DOE's interaction with the Purchasers in implementing the provisions of the Standard Disposal Contract. The currently projected annual acceptance capacity to be allocated is discussed and presented in Section 2.0. Section 3.0 discusses the procedure and basis for allocation of this capacity (acceptance rights). Allocation will be based on the chronological listing of spent fuel assemblies and equivalent MTU. Some of the contingencies which may have an impact on Contract implementation and system operation considerations which could affect the projected annual capacity and its allocation are identified in Section 4.0. 4 refs., 11 tabs.

3062 **(DOE/WIPP—87-006) 1987 annual water quality data report for the Waste Isolation Pilot Plant.** Uhland, D.W.; Randall, W.S.; Carrasco, R.C. (Westinghouse Electric Corp., Carlsbad, NM (USA). Engineering and Repository Technology Dept.; I. T. Corp., Carlsbad, NM (USA)). Mar 1987. Contract AC04-86AL31950. 267p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000255/JAW.

The Waste Isolation Pilot Plant (WIPP), a Department of Energy facility located in southeastern New Mexico, is designed to demonstrate the safe disposal of transuranic radioactive waste resulting from the nation's defense programs. The Water Quality Sampling Program (WQSP) supports four major programs for the WIPP: site characterization, the Performance Assessment, Radiological Baseline Program, and the Ecological Monitoring Program. Results from 13 wells sampled under the WQSP are presented in this report. Water quality data from three water-bearing zones have been collected. These zones are the Culebra and Magenta Dolomite Members of the Rustler Formation and the Dewey Lake Red Beds. Results presented from the sampling include field chemistry data, general water quality parameters, trace metals, and priority pollutants. 15 refs., 55 figs., 54 tabs.

3063 **(DP-MS—86-150) Operational testing of an electrically fired Pu-238 waste incineration process.** Holmes, H.; Charlesworth, D.L. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 12p. (CONF-870306—66). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000793/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Combustible ^{238}Pu waste is generated from normal operation and decommissioning activity at the Savannah River Plant and is being retrievably stored at the Plant. An electrically fired, two-stage incineration process is being developed to use incineration to process and recovery plutonium from the waste. A prototype incinerator is being tested to assess its capability to be remotely operated and maintained. Technical development is focusing on continuous feeding, vacuum control, remote operability and mechanical integrity of the system, ash burnout, and life of the belt in the primary incinerator chamber. 6 figs., 5 tabs.

3064 **(DP-MS—87-95-Rev.) Slag-based saltstone formulations.** Langton, C.A. (Savannah River Lab., Aiken, SC (USA)). 25 Aug 1987. Contract AC09-76SR00001. 12p. (CONF-870859—10-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014844/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Approximately 400 x 10^6 liters of low-level alkaline salt solution will be treated at the Savannah River Plant (SRP) Defense Waste Processing Facility (DWPF) prior to disposal in concrete vaults at SRP. Treatment involves removal of Cs^+ and Sr^{+2} followed by solidification and stabilization of potential contaminants in saltstone, a hydrated ceramic waste form. Chromium, technetium, and nitrate releases from saltstone can be significantly reduced by substituting hydraulic blast furnace slag for portland cement in the formulation designs. Slag-based mixes are also compatible with Class F fly ash used in saltstone as a functional extender to control heat of hydration and reduce permeability. A monolithic waste form is produced by the hydration of the slag and fly ash. Soluble ion release (NO_3^-) is controlled by the saltstone microstructure. Chromium and technetium are less leachable from slag mixes compared to cement-based waste forms because these species are chemically reduced to a lower valence state by ferrous iron in the slag and precipitated as relatively insoluble phases, such as $CR(OH)_3$ and TcO_2. 5 refs., 4 figs., 4 tabs.

3065 **(DP-MS—87-104) The Savannah River Plant low-level waste segregation program.** Wheeler, V.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 7p. (CONF-870859—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000794/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

To extend the life of the Savannah River Plant (SRP) Radioactive Waste Burial Ground, a sitewide program has been implemented to segregate waste that is essentially free of contamination from routine radioactive waste. Much of the low-level waste disposed of as radioactive has no detectable contamination and can be buried in a sanitary landfill. A Landfill Monitoring Facility (LMF) will be constructed at SRP to house the state-of-the-art technology

required to provide a final survey on the candidate waste streams that had previously been classified as radioactive. 3 figs.

3066 **(DP-MS—87-126) Calculation of groundwater recharge at the old SRP burial ground using the CREAMS model (1961-1986).** Hubbard, J.E.; Englehardt, M. (State Univ. of New York, Brockport (USA). Dept. of Earth Sciences; Arizona Univ., Tucson (USA). Dept. of Geological Engineering; Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000790/JAW.

The CREAMS computer simulation model was used to calculate a water balance for the old SRP burial ground for the period 1961 to 1986. Daily rainfall records from F-Area Separations were used in the simulation; soils, vegetation, and climatic characteristics of the burial ground site were used for the hydrologic parameters in the model. Average annual recharge is 14.7 inches as calculated by CREAMS, about the same as the normal recharge for the site and slightly less than one-third the normal rainfall. The extremes are 32 inches in 1964 and 4 inches in 1968, and 8.7 inches of recharge in the recent drought year 1986. CREAMS results confirm that most recharge occurs in winter and spring months. In some years large amounts of recharge have occurred in summer months. 4 refs., 4 figs., 1 tab.

3067 **(DPST—87-377) DWPF liquid sample station: Status of equipment development.** Caplan, J.R. (Savannah River Lab., Aiken, SC (USA). Technical Div.). 6 Apr 1987. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000771/JAW.

This report summarizes operating experience and equipment status of the DWPF liquid sample cell. Operation hours to date, results of equipment inspections and problems encountered and their solutions are discussed. An equipment and instrumentation status updating DPST-85-592, DWPF LIQUID SAMPLE CELL MOCK-UP, is presented. Remaining development items are also outlined.

3068 **(EGG—2502) Environmental surveillance for the EG and G Idaho Radioactive Waste Management areas at the Idaho National Engineering Laboratory.** Reyes, B.D.; Tkachyk, J.W.; Ritter, P.D.; Wilhelmsen, R.N. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87014261/JAW.

The 1986 environmental surveillance report for the radioactive waste management areas at the Idaho National Engineering Laboratory describes environmental monitoring activities at the Radioactive Waste Management Complex, the Waste Experimental Reduction Facility, the Radioactive Mixed Waste Storage Facility, the Process Experimental Pilot Plant, and two surplus facilities. The purposes of these monitoring activities are to provide for continuous evaluation and awareness of environmental conditions resulting from current operations, to detect significant trends, and to project possible future conditions. This report provides a public record comparing Radioactive Waste Management Complex, Waste Experimental Reduction Facility, Radioactive Mixed Waste Storage Facility, Process Experimental Pilot Plant, and surplus facility environmental data with past results and derived concentration guides established for operation of Department of Energy facilities. 10 refs., 41 figs., 16 tabs.

3069 **(EGG-M—05887) Decontamination and decommissioning of the MTR [Materials Testing Reactor]-603 HB-2 cubicle.** Smith, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 18p. (CONF-871018—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014880/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the decontamination and decommissioning (D & D) of the MTR-603 HB-2 cubicle located at the Idaho National Engineering Laboratory (INEL). The HB-2 cubicle became radioactively contaminated during out-of-pile circulating water loop experiments conducted in the Materials Testing Reactor in the 1950s and 1960s. This paper describes work performed to accomplish the D & D objectives of reducing the high radiation fields caused by contamination inside the cubicle, preventing future contamination spread, and making about 1400 ft^2 of floor space available for reuse. Decommissioning of the HB-2 cubicle consisted of total dismantlement of the cubicle and its contents and was performed without disrupting ongoing laboratory work being conducted in areas surrounding the HB-2 cubicle. 3 refs., 7 figs., 4 tabs.

3070 **(EUR—10601) Geotechnical deep ocean research apparatus (DORA).** (Commission of the European Communities, Luxembourg). 1986. 207p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750659/JAW.

As part of the research programme on radioactive waste disposal in seabed geological formations, a Deep Ocean Research Apparatus (DORA) seabed machine has been conceptually designed and prototypes of principal subsystems built and tested by four DORA Project partners. The DORA is designed to operate in 6000 m of water and drive a string of test rods and a piezocone about 50 m into soft soil. Partner responsibility was Fugro for project management and the penetration apparatus; ISMES for data acquisition and control; Laboratorium voor Grondmechanica for the piezocone probe and its sensors; and Marine Structure Consultants for the mission profile and DORA handling requirements. The DORA will have a maximum thrust of 50 kN. The probe will measure cone resistance, sleeve friction, pore pressure and inclination. Stability on the seabed will be assisted by using a combination of polyester and polypropylene-nylon (double) braided rope. A continuous wheel-drive subsystem will drive the test rods. Gelled or lead-acid batteries can power a hydraulic powerpack. Acoustic data transmission will be used. Software for data processing automation has been tested with simulation of all input channels. Successful operation of subsystem prototypes indicates that a DORA can be constructed at any future time for use on fundamental or applied deep ocean science and seafloor engineering investigations by industry, government and universities.

3071 **(EUR—10760) Community project COSA: comparison of geo-mechanical computer codes for salt.** Lowe, M.J.S.; Knowles, N.C. (Atkins Research and Development, Epsom, UK). (Commission of the European Communities, Luxembourg). 1986. 265p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750660/JAW.

Two benchmark problems related to waste disposal in salt were tackled by ten European organisations using twelve rock-mechanics finite element computer codes. The two problems represented increasing complexity with first a hypothetical verification and then the simulation of a laboratory experiment. The project allowed to ascertain a shapshot of the current combined expertise of European organisations in the modelling of salt behaviour.

3072 **(EUR—10821) Development of waste unit for use in shallow land burial.** Brodersen, K. (Commission of the European Communities, Luxembourg). 1986. 215p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750498/JAW.

A hexagonal waste unit has been developed for use in shallow land burial of low- and medium-level radioactive waste. The waste units used as overpack on empty standard 210 1 drums have been tested for tightness and mechanical resistance. Experimental burial of 21 empty full-size units has demonstrated the emplacement of the containers and the sealing of the crevises between them with molten bitumen. The development of the experimental burial with time is being followed. Three different conceptual designs for advanced burial systems using the hexagonal standard units are described. The outer barrier is a thick concrete structure covered by 2, 10 or 20 m soil, respectively. The waste units were cast from a normal high-quality concrete as well as from Densit, a new, very strong and impermeable type of concrete prepared by the combined use of silica-fume (microsilica) and a superplastizicer as additives. The migration of Cl/sup -/, Cs/sup +/ and tritiated water was found to be much slower in Densit than in normal concrete. In combination with leaching measurements for Cs/sup +/ from the same materials the results are used to present some theoretical considerations concerning transport through solution-filled pore systems as dependent on pore-size distribution, tortuosity, etc. A

method based on neutron-activated cement cast in form of thin plates has been developed and used to study the dissolution chemistry of concrete. A preliminary model is presented. Indications for precipitation mechanisms were obtained. Densit was demonstrated to ensure a high degree of corrosion protection for steel reinforcement. The reason is mainly the high electrical resistivity combined with low diffusive transport in the material. The pozzolanic reaction results in somewhat lower pH in the pore water than in normal concrete, but the effect is not so pronounced that the passivation of steel reinforcement is endangered.

3073 **(EUR—10824) Conditioning of cladding waste for long-term storage by press compaction and encapsulation in lead containment.** Regge, P. de. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). (Commission of the European Communities, Luxembourg). 1986. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750663/JAW.

The conditioning of compacted cladding waste has been based on the concept of a corrosion-resistant containment. The technique of press compaction in remote operation conditions has been demonstrated. Detailed specifications of the design of the container are discussed in the report. Testing procedures for the different containment parts have been developed and applied. The remote welding techniques of the stainless steel and lead-based parts of the containment have been investigated and reliable procedures are reported. A technique for remote leak-testing of welded containers is described. The report contains a series of pictures documenting the entire conditioning concept, starting from the dissolver basket at the reprocessing stage up to the final disposal container.

3074 **(EUR—10848(v.2)) Feasibility study for the design of a simulated radioactive waste repository facility. Volume 2 - figures - tables.** (Commission of the European Communities, Luxembourg). 1987. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750665/JAW.

The report is in two volumes: volume 1 contains the main text and the references, and volume 2, all the figures and tables. The great majority of published concepts for the disposal of heat generating radioactive waste envisage the emplacement of waste packages in boreholes backfilled with an engineered material described as the buffer. The need for a full scale experimental programme to investigate buffer placement and performance was identified, and this report describes the first stage in the development of that programme. The nature of candidate buffer materials and the factors defining their behaviour have been reviewed and the nature of a buffer material selection and testing programme have been outlined. The properties of crystalline rocks, saliferous formations and clay host materials have been reviewed and the complex interactions between them have been identified. The difficulty of modelling these properties and the interaction between buffer and host materials has been discussed and the instrumentation requirements for measuring this interaction have been outlined. A limited amount of thermomechanical analysis has been performed to give a preliminary indication of the parameters of major significance in selection of instrumentation and modelling materials. It has been concluded that a complete simulation of host material properties is not presently viable , although it may be attainable for some crystalline rock types. Alternative strategies for assessment of the host/buffer interaction are suggested.

3075 **(EUR—10848-Vol.1) Feasibility study for the design of a simulated radioactive waste repository facility. Volume 1. Text-References.** Mott; Hay; Anderson. (Commission of the European Communities, Luxembourg). 1987. 139p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750499/JAW.

The report is in two volumes: Volume 1 contains the main text and the references, and volume 2, all the figures and tables. The great majority of published concepts for the disposal of heat generating radioactive waste envisage the emplacement of waste packages in boreholes backfilled with an engineered material described as the buffer. The need for a full scale experimental programme to investigate buffer placement and performance was identified, and this report describes the first stage in the development of that programme. The nature of candidate buffer materials and the factors defining their behaviour have been reviewed and the nature of a buffer material selection and testing programme have been outlined. The properties of crystalline rocks, saliferous formations and clay host materials have been reviewed and the complex interactions between them have been identified. The difficulty of modelling these properties and the interaction between buffer and host materials has been discussed and the instrumentation requirements for measuring this interaction have been outlined. A limited amount of thermomechanical analysis has been performed to give a preliminary indication of the parameters of major significance in selection of instrumentation and modelling materials. It has been concluded that a complete simulation of host material properties is not presently viable, although it may be attainable for some crystalline rock types. Alternative strategies for assessment of the host/buffer interaction are suggested.

3076 **(EUR—10941) Community project on engineering aspects of backfilling and sealing of radioactive waste repositories.** Lake, L.M.; Bennett, A. (Commission of the European Communities, Luxembourg). 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750500/JAW.

This report summarizes the work carried out under CEC contracts about engineering aspects of backfilling and sealing of radioactive waste repositories, for the time period 1983-84. It complements a previous report (ref. EUR 9283) on the same topic, this latter covering the period 1980-82.

3077 **(FLPU—86-9) Role of faults in the hydrogeological environment.** Black, J.H.; Alexander, J.; Jackson, P.D.; Kimbell, G.S.; Lake, R.D. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). Sep 1986. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750216/JAW.

Depending on rock type (limestones, mudrocks etc), faults in mixed sedimentary rocks are variously assumed to enhance or reduce groundwater flow. The report attempts to erect a very broad classification system based on fault-associated phenomena to identify geological environments in which faults might be expected to be more permeable than surrounding rock. The manner in which faults (of enhanced or decreased permeability) could be expected to influence groundwater flow is briefly assessed. It shows that for faults to be important they must either have strongly changed properties, occur frequently, or almost cut the low permeability rocks in the system. A final section on the use of geophysics to identify faults in mudrocks picks out seismic reflection and resistivity methods as the most promising. Detection limits are calculated.

3078 **(INIS-BR—881) Analytical hierarchy theory as applied to low level radioactive waste repository siting.** Santos, J.M.E. dos; Barros Santos, M. de. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 1p. (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700415/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

Published in summary form only.

3079 **(INIS-mf—10731) Final conditioning of high-level liquid radioactive waste.** Krause, H. (Kerntechnische Gesellschaft e.V., Bonn (Germany, F.R.). Fachgruppe Reaktorsicherheit; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). 1981. 16p. (In German). (CONF-8106316—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750430/JAW.

From Seminar of safety aspects in transport and storage of spent fuel elements and HAW; Stuttgart, F.R. Germany (3 Jun 1981).

Problems of the solidification of HLLW from the reprocessing stage are discussed. The matrix for embedding the 37 different fission products and the 5 actinides is of great importance in this

context. In addition to glass, there is a number of other candidate materials, as e.g. 'super calcine' or 'synroc', which however need further research and experimental studies, as results so far are not so satisfactory. Vitrification is the most advanced technical method currently, and is practically applied in France's AVM installation and further tested in simulation experiments. A variant developed by KfK, vitrification in a ceramic melter with electrode heating, is explained by this paper.

3080 (INIS-mf—11045, pp 85-125) **Geology of the Vaalputs radioactive waste disposal site in the Republic of South Africa. Explanatory notes for the geological map of the site on the scale 1:25,000.** Andreoli, M.A.G.; Andersen, N.J.B.; Levin, M.; Niemand, N. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The Vaalputs site is underlain by an extensive veneer of Tertiary and Quaternary deposits covering a crystalline basement of Precambrian age. The unfaulted, highly impermeable nature of the Vaalputs formation renders it very suitable for the safe disposal of low- to medium-level radioactive waste in the area selected. However, the numerous faults and shear zones in the granitic and gneissic basement will need in-depth investigations should a high-level radwaste repository be required. A geological map, as well as explanatory notes therefore, is given.

3081 (INIS-mf—11045, pp 317-332) **Resistivity studies on the Vaalputs radioactive waste disposal site.** De Beer, J.H.; Blume, J. (Council for Scientific and Industrial Research, Pretoria, South Africa. National Physical Research Lab.). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

During 1983 a ground geoelectrical survey was done on the farms selected for the proposed radioactive waste disposal site. The primary aims were to outline basins of weathering and to delineate faults, fracture zones and aquifers. The methods used were the Schlumberger electrical sounding technique and the rectangle profiling method. In total 167 Schlumberger soundings and 124km of rectangle profiling were done. The investigation of linears, detected by means of remote sensing methods, showed that some of these features are related to faulting and fracturing, but these faults are not always continuous. The selected areas, chosen for more detailed investigation on the basis of the already available geophysical and geological data, proved to have no anomalies suggesting major fracturing or faulting of the basement. During 1984 a 1km x 1,6km rectangle selected for the repository was studied in detail by 220 Schlumberger soundings positioned mostly on a 100m x 100m grid. The interpretation of the sounding data in conjunction with the borehole data showed that the upper surface of the solid basement is uneven and that it varies in elevation between 982m and 1005m amsl within the 1,6km/sup 2/ area. This corresponds to an overburden thickness that varies from 6,6m to 36,5m. A zone with large values of total longitudinal conductance and thicker than normal overburden running roughly north-south through the rectangle was delineated geophysically and proved by drilling. Four of the five boreholes drilled in this zone, yielded water and the other intersected basic rock. The thickening in overburden along this zone seems to relate to a feature in the basement which could be a linear zone of jointing or faulting.

3082 (INIS-mf—11045, pp 149-161) **Modelling contaminant transport using site specific data from Vaalputs.** Botha, J.F. (University of the Orange Free State, Bloemfontein, South Africa. Inst. for Ground Water Studies). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The transport of a contaminant through the upper layers of the earth's surface is a complex phenomenon. To develop a model for this, requires a good understanding of the physical nature of the phenomenon. This paper discusses two difficulties frequently encountered in developing such a model - the nature of the subsurface and the mathematical representation of the unsaturated hydraulic parameters. It is proposed that information obtained from pump-and packer tests be used to circumvent the first difficulty, and that the unsaturated flow parameters be approximated by C/sup -∞/ continuous function.

3083 (INIS-mf—11045, pp 547-589) **Geohydrology of the Vaalputs radioactive waste disposal facility.** Levin, M.; Hambleton-Jones, B.B.; Raubenheimer, E.; Niemand, N. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

One of the most important factors in the characterization of a low-level waste disposal site is a knowledge of the movement of water in both the unsaturated and saturated zones. These are aspects that received much attention at the Vaalputs radioactive waste disposal facility. A model was developed to predict long-term behaviour of groundwater movement and the consequent migration of radionuclides. Modelling of the groundwater at Vaalputs was divided into calibration and verification phases, the latter being still in progress. During the calibration phase certain parameters such as the hydraulic conductivity, hydrodynamic dispersion coefficient, distribution coefficient and soil moisture were determined in the unsaturated zone below the proposed trenches. In addition to the above, isotope analyses of tritium and /sup 18/O in the soil moisture were undertaken to study the rate of soil moisture movement in the surficial material of the unsaturated zone. Chemical analyses of this material indicate that percolation is inhibited as a result of the high inherent salinity. The favourable site characteristics, backed by the geomorphological stability of the area, make the Vaalputs radioactive waste disposal facility one of the most suitable sites available in the world.

3084 (INIS-mf—11045, pp 825-836) **Modelling and prediction of radionuclide migration from shallow, subgrade nuclear waste facilities in arid environments.** Smith, A.; Ward, A.; Geldenhuis, S. (Steffen, Robertson and Kirsten, B.C. Inc., Canada; Steffen, Robertson and Kirsten, Mining Inc., South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Over the past fifteen years, prodigious efforts and significant advances have been made in methods of prediction of the migration rate of dissolved species in aqueous systems. Despite such work, there remain formidable obstacles in prediction of solute transport in the unsaturated zone over the long time periods necessarily related to the radionuclide bearing wastes. The objective of this paper is to consider the methods, issues and problems with the use of predictive solute transport models for radionuclide migration from nuclear waste disposal in arid environments, if and when engineering containment of the waste fails. Having considered the ability for long term solute prediction for a number of geological environments, the advantages of a disposal environment in which the solute transport process is diffusion controlled will be described.

3085 (INIS-mf—11045, pp 333-350) **Impact assessment of buried low-level wastes under unsaturated flow conditions.** Eichholz, G.G. (Georgia Inst. of Tech., Atlanta, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The environmental impact assessment of a shallow land burial site for LLW depends on a realistic assessment of the actual and worst-case infiltration rate for water, the retention and drainage capacity of the trench backfill and underlying soil, the leach rate under unsaturated flow conditions, and the ion exchange properties of the soil. Additional factors of importance are the pH of the water after equilibration with the soil, the existence of suspended particulates, the presence of any chelating reagents in the waste, the residual moisture content of the soil, and any tendency to crack formation. Extensive modeling has been done to simulate 1D and 3D dispersion effects in waste sites. The presence of interfaces and interstices can affect flow patterns and reduce the source term, or conversely increase it by causing ponding. The installation of trench floor drainage can significantly reduce the source term but only for soils with a low residual moisture value. For areas of low or lightly intermittent rain fall conventional models tend to overestimate impact by assuming flooding of the site and saturated flow conditions. To be meaningful a model must incorporate highly site-specific parameters and the drainage conditions of the site must be planned carefully.

3086 (INIS-mf—11045, pp 365-379) **Site selection issues for radioactive waste disposal in arid regions of the United States.** Gaynor, R.K. (US Ecology Consultants, Newport Beach, California, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

In the United States, shallow land burial has been the principal method of low-level radioactive waste disposal for the past 24 years. Experience has included disposal sites in both arid and humid environments. This paper provides a general overview of the experience to date at the arid sites with contrasts to the humid site experience. Current practices are reviewed with respect to surface water management, trench construction and disposal operations, environmental monitoring of air, water, groundwater, soil and vegetation. As a result of recent federal legislation, new disposal sites are soon to be developed in various regions of the country. Site selection, licensing and development of these new facilities will be governed by federal regulations which have been developed on the basis of past experience and research. Title 10 Code of Federal Regulations Part 61, 'Licensing Requirements for Land Disposal of Radioactive Waste', sets forth certain site suitability requirements and performance objectives with respect to acceptable levels of impact to man and the environment. Guidelines for the site selection process and site characterization are also provided. In this paper, these requirements and their conceptual bases are discussed, particularly in relation to implementation at an arid location. Another rule, 40 Code of Federal Regulations Part 193 is being developed to establish 'Standards for Low-Level Radioactive Waste Disposal'. This rule is being supported by a risk assessment computer model developed by the United States Environmental Protection Agency.

3087 (INIS-mf—11045, pp 417-434) **Botanical aspects of the ecological integrity of a radioactive waste disposal site.** Hall, A.V. (Cape Town Univ., South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Botanical factors play a key role in maintaining the long term integrity of ecosystems. The results of botanical research at the Vaalputs radioactive waste disposal site in Bushmanland, South Africa, are outlined. Vaalputs is in an arid region and its vegetation is a patchy mosaic of low shrub and grass communities. Soil variation from site to site is the main determinant of community structure and erratic precipitation is a major stochastic forcing factor. Management measures to conserve taxa, ecosystems and local genetic biogeography are discussed in relation to natural and artificial disturbances which may occur over long time-scales. Restoration of vegetation over the burial trenches should as far as possible be to the site's former ecotypes except that deep-rooted species should be excluded. Precautions should be taken against the accidental establishment of exotic plant invaders at Vaalputs especially if they are deep-rooted. More is now known about plant ecology at Vaalputs than any other part of Bushmanland. It would be valuable to develop such studies further and establish Vaalputs as a permanent reserve for arid-zone biological research.

3088 (INIS-mf—11045, pp 523-545) **Swedish studies of high-level waste disposal in crystalline rock.** Krauskopf, K.B. (Stanford Univ., CA, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Crystalline rock as a medium for the disposal of high-level nuclear waste is under consideration in many countries, and is being studied intensively in Sweden. Swedish scientists have explored in great detail several areas underlain by granite and schist, using surface mapping, many drillholes, and geophysical techniques. Prediction of subsurface conditions from the surface exploration has enabled them to eliminate some areas on the basis of too much fracturing, and to find a few areas where volumes of nearly unfractured rock exist that are adequate for repository construction. Studies of permeability and groundwater composition have made possible predictions about rates of escape of radionuclides from a breached repository. Especially notable is Swedish research on flow of ground water in fractured rock and on retardation of radionuclides by sorption and dispersion. In addition to field studies, Swedish scientists have established an underground laboratory in granite, where in-situ studies are under way on the effects of heating and radiation and on techniques of backfilling and sealing of tunnels.

3089 (INIS-mf—11045, pp 645-663) **Zoological aspects of the ecological integrity of a radioactive waste disposal site.** Nel, J.A.J.; Picker, M.D.; Robinson, T.J. (Stellenbosch Univ., South Africa; Cape Town Univ., South Africa. Dept. of Zoology; Mammal Research Institute, University of Pretoria, South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The possible effects of nuclear waste disposal at the Vaalputs terrain on the endemic fauna are being monitored by assessing changes in the occurrence of small mammal species, their density, food, reproduction, parasite load, gross abnormalities and longevity, as well as the occurrence of chromosome and chromatid lesions. Interactions between the radiation source and animals are studied by monitoring burrowing activity of arthropods, and the soil they transfer to the surface, as well as the burrowing activity of rodent species.

3090 (INIS-mf—11045, pp 915-933) **Selection criteria for a radioactive waste disposal site in the Republic of South Africa.** Toens, P.D.; Hambleton-Jones, B.B. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

A program commenced in 1978 to select a suitable site for the disposal of nuclear waste in South Africa. This entailed the examination of a variety of socio-economic and earthscience related parameters over large parts of South Africa. The site selection program, for which the Geology Department of the Atomic Energy Corporation of South Africa Ltd (AEC) (previously the Nuclear Development Corporation (NUCOR)) accepted responsibility, commenced with an initial screening phase and led to the identification of potentially suitable areas by mid 1980. A site suitability phase involving regional, and subsequently detailed socio-economic, geological, geohydrological and geophysical studies in the areas identified by the screening phase was completed in December 1982. As a result of very positive indications that the district of Namaqualand was the most suitable candidate area it was possible, after further

detailed investigations, to identify and purchase a site judged to be suitable for the disposal of low- and intermediate-level waste by February 1983. The area acquired measures some 10,000ha in extent and is situated 100km southeast of Springbok in the northwestern Cape and 600km north of the Koeberg nuclear power station near Cape Town.

3091 (INIS-mf—11045, pp 943-961) **Vaalputs radiological environmental monitoring programme.** Van As, D.; Posnik, S.J.; Bain, C.A.R. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

An environmental monitoring programme was initiated two years before radioactive waste was due to be disposed of at the Vaalputs site. During this time a database was established against which future changes in the radiation levels of the environment could be measured. The monitoring network included the measurement of radiation doses, radioactivity levels in soil, vegetation, groundwater, and agricultural produce. A natural radiation dose to the average individual of 2,2 mSv per annum was established. Meteorological parameters were collected and used to assess the potential release and transport of radioactivity through the environment. A survey of the habits of the surrounding population was conducted to identify the principal food chains. In addition to complying with the licensing requirements for the waste disposal site, the environmental monitoring programme is contributing valuable scientific information on evapotranspiration and percolation in semi-arid environments.

3092 (INIS-mf—11045, pp 35-56) **Compliance of the Vaalputs national radioactive waste disposal facility to a frequency-magnitude release criterion as required for licensing.** Adrian, H.W.W.; Gerber, H.H.; Kruger, J.; Weygand, J. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Accidental releases of radioactivity from the Vaalputs nuclear waste repository have been quantified and release frequencies have been attached to a number of accident scenarios of human or natural origin. These have then been compared to a frequency-magnitude release criterion according to South African licensing requirements. It was shown that the criterion was applicable in three release bands. In two of these the criterion was met by some orders of magnitude. In the third band the permitted release frequency was a factor 55 below the limit in spite of pessimistic release assumptions.

3093 (INIS-mf—11045, pp 351-363) **Methodology for performing safety assessments for potential radioactive waste disposal facilities.** Fitzpatrick, J.; Gralewski, Z.A.; Vande Putte, D.; Waplington, G. (Electrowatt Engineering Services Ltd., Horsham, UK). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Current strategies for the management of all types of radioactive wastes have as their ultimate aim the disposal of these wastes safely isolated from man's environment. The primary concern in establishing the suitability of a site is the safety of disposal and therefore an essential requirement is a safety assessment. This paper outlines a methodology developed by Electrowatt Engineering Services (UK) Limited for performing safety assessments of radioactive waste disposal systems. The methodology consists of a step by step approach from establishing the virgin site characteristics, to predicting the risk from releases in the future (up to millions of years). Both simple and more complex mathematical models are used. The simpler models are used to give a first indication of the safety of the system and to help identify data requirements for more complex models. The disposal system is divided into three regions namely near field, far field and biosphere. In the near field the effectiveness of the chosen engineered barriers are assessed in terms of their ability to provide both physical and chemical containment of the radionuclides. For the far field the ability of the chosen site is assessed in terms of inhibiting the transport of nuclides from the near field to the biosphere. Both a reference system and release enhancing scenarios are assessed. In the biosphere various exposure pathways can be analysed based on current human habits and projected future hypothetical practices.

3094 (INIS-mf—11045, pp 1001-1018) **Speciation aspects of predictive modelling in radioactive waste disposal.** Williams, D.R. (University of Wales Inst. of Science and Technology, Cardiff, UK). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

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Our environment is precious and has to be protected by scientists choosing the very best disposal site which minimises the environmental impact of radioactive waste when eventually it leaks from a disposal vault and reaches man. Such disposal systems have to be acceptable to scientists, to the public who reside in the country concerned, and also to international bodies. A full appraisal of the risk assessment involves studying the detailed chemistry of the waste packaging, of the disposal vault, of the geosphere, and of the biosphere. The amounts and speeds through which radioactive waste components travel from packaging through to the biosphere are critically dependent upon the specific speciation occurring. To chemists and geochemists, 'speciation' refers to the different chemical forms in which an element exists as a solid, liquid, gas, or as a range of complexes in solution. Countries which have had a nuclear power programme for many years use large computer models in order to assess the likely risks from a given waste disposal scenario. A detailed representation of the speciation chemistry is necessary as input into these models and for cross-verification and validation exercises. This requires two types of speciation programs - those that calculate species present at equilibrium and those which can assess mass transfer phenomena.

3095 (INIS-mf—11045) **Radwaste '86: proceedings volume. Conference on the treatment and containment of radioactive waste, and its disposal in arid environments.** Ainslie, L.C. (ed.). (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Dec 1986. 1048p. (CONF-860909—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW.

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The volume contains all the papers presented at the above Conference, which was held in Cape Town, South Africa from 7 to 12 September 1986. A total of 55 contributions cover the full spectrum of the theme of the Conference, which was subdivided into four sessions. Conditioning, treatment and management of radioactive waste: 12 papers reporting on experiences in various countries, as well as specialist topics such as the extraction of radioactive contaminants from reactor pool water. Containment, safe handling and long-term integrity of ILLW packages: 2 papers dealing with cask design. Transport and storage of radwaste and spent fuel: 7 papers ranging from broad overviews to specific operations in different parts of the world. Radioactive waste disposal and environmental impact: 32 papers covering topics from site selection, design and operation, to modelling and monitoring studies. South Africa's Vaalputs radioactive waste disposal facility is comprehensively described. The volume is a useful reference for anyone interested in the disposal of radioactive waste, especially in arid environments, as well as its treatment and management prior to disposal, and will appeal to a wide range of disciplines including engineers, geologists, geophysicists, life scientists and environmentalists. Of particular interest would be the intensive studies undertaken in South Africa prior to the establishment of a radioactive waste repository in that country.

3096 (INIS-mf—11045, pp 183-188) **Resin drying in high integrity containers: advanced waste stabilization methodology.** Carson, M.P. (Nupac Services Inc., Columbia, South Carolina, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

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Pre-disposal stabilization requirements for spent ion-exchange media (radioactive waste) have become more stringent over the past ten years. These stiffening requirements have consequently increased the need for performance oriented processing equipment and methodologies, for processing waste ion-exchange media (resins). Current U. S. requirements (10CF61) mandate that waste forms contain less than 1% by volume, of free standing water (FSW), when presented for disposal. This equally applies to ion-exchange resins stabilized by packaging inside a high integrity container. A modular resin drying system was designed and constructed by Nuclear Packaging, for use by NuPac Services to provide waste resin processing services to U. S. nuclear utilities. The drying system is used to dry the resins after they are packaged inside a NuPac high integrity container. Extensive developmental tests were conducted and successfully demonstrated the system's ability and capacity to remove free standing water in excess of the requirements of 10CFR61. These comprehensive full-scale tests were conducted during the design and engineering phase of system development, using instrumented containers. Extensive computer modeling was also performed concurrent with the full-scale testing. This approach provided demonstration of the systems ability to meet regulatory requirements as well as develop and validate a computer model that is used to predict system behavior under varying conditions. The resultant is a technologically advanced drying system that very closely conforms to theoretical water removal models for resin beds. These performance capabilities provide for reduced radiation exposure to operators, enhanced volumetric efficiency for disposable ion-exchange media, and improved economics for transport and disposal.

3097 (INIS-mf—11045, pp 201-224) **Treatment of wet solid low-level radioactive waste.** Chou, T-S.; Lee, Y-D. (Institute of Nuclear Energy Research, Atomic Energy Council, Taiwan, Republic of China; Department of Chemical Engineering, National Tsing Hua University, Hsinchu, Taiwan, Republic of China). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Recently low-level radioactive waste has caused much concern because of its long term impact on the environment. Most of the low-level radioactive waste is produced by nuclear power plants while a small fraction comes from medical applications, for example, radioactive isotopes. This waste exists in gas, liquid and solid forms. Research was carried out on wet solid low-level wastes, which were treated with polymeric materials. Their properties and applications were studied and evaluated. Wet solid radioactive wastes come from evaporated condensates produced by light-water reactors. The main component of boiling-water reactor waste is Na/sub 2/SO/sub 4/ and that of pressure-water reactor waste is H/sub 3/BO/sub 3/. Furthermore the spent ion exchange resin also constitutes a major portion of the solid radioactive waste. In this research, unsaturated polyesters, such as ETERSET 2565P and 2144 HCM, were employed to solidify the wastes; i.e. Na/sub 2/SO/sub 4/, Ca/sub 3/(BO/sub 3/)/sub 2/.2H/sub 2/O, cationic ion exchange resin Duolite ARA 9366 and anionic ion exchange resin Duolite ARC 9351. It was found that the properties, such as density, compressive strength, water resistance and thermal stability of unsaturated polyester solidified wastes were excellent. The radiation resistance could be as high as 10/sup 8/ Rad and the leachability was low. The volume reduction ratios of all samples were better than those of cement solidified waste.

3098 (INIS-mf—11045, pp 253-271) **Evaluation of the production of solid radio-active waste in the Tricastin nuclear power station and, more generally, in the other French nuclear power stations.** Cuisenier, R.G. (Electricite De France, BP9, 26130 Saint Paul-3-Chateaux, France). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

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The importance of the effect of processing and packaging of solid radio-active wastes on the necessary staff, on the dosimetry acquired by this personnel and on the running costs will be presented, thus permitting a quantitative evaluation of the different types of waste produced, not only for the Tricastin plant but also for any typical French nuclear plant. Experience in the Tricastin power plant has shown that the volume of solid wastes can vary considerably depending on the different problems which can arise during production (cooling system leaks or less regular incidents). The different techniques used will be relooked at in order to facilitate the explanation of these fluctuations in the volume of waste produced and the measures which can be taken to limit them. The different measures which have been taken to improve performance in this domain will be presented: improvements in equipment, in methods, and in the increased awareness of the personnel concerning these problems.

3099 (INIS-mf—11045, pp 291-315) **Characterization of products arising from the incorporation of low- and medium-level waste in cement or polymer matrix.** De Angelis, G.; Caropreso, G. (ENEA, Rome, Italy). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

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The incorporation of LLW and MLW in an inert matrix gives rise to products which have to be characterized in order to evaluate their behaviour under accident conditions during interim storage, transport and final disposal and to predict, as far as possible, the long-term durability of the solidified waste forms. Due to the lack of a unique standard regulation several tests are currently employed with the general aim to achieve a complete knowledge of the products under consideration. They include compressive strength, drop test, penetration test, hardness, impact resistance, dispersibility test, tensile test, flexural strength, high temperature resistance, fire test, freezing-and-thawing cycles, leachability, evaluation of porosity and permeability, thermogravimetric analysis, optical and electron microscopy. Some process parameters, such as set time, viscosity, workability, and heat evolution, which can influence the final properties of these materials, have also to be considered. Moreover studies concerning the waste/matrix compatibility can help to predict the long-term behaviour. A general comprehension of the problems involved however can be achieved only by considering the system solidified waste/drum/final repository as a whole, and taking into account the possible interactions. The present work is a presentation of the most important characterization methods, with the indication of the regulations followed. A brief review of the principal waste streams with notes concerning the problems which their incorporation poses is also given.

3100 (INIS-mf—11045, pp 381-391) **Incineration of burnable low-level waste.** Grabener, K.H.; Kirchenmayer, A.; Wasinger, K.L.V. (Kraftwerk Union A.G., Offenbach am Main, Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

At the German research centres in Karlsruhe and Juelich, incinerators for volume reduction of burnable radwaste have been developed and operated for many years. The first commercial incinerator in Germany started its operation this year at the KWU service centre in Karlstein. The principle of the incineration corresponds to the 'Juelich Incineration Process'. The capacity of the plant is 100

kg/h. Incineration takes place in two stages: Stage 1: the waste is pyrolyzed; Stage 2: the pyrolyzed products are burnt. The off-gas is filtered in three units so that the release of radionuclides is minimized. Operation experience will be reported in the paper. The burnable waste is transported from the power plants by rail or by truck to the incinerator for volume reduction. The ash and the rest of the non-burnable components are subsequently compacted and fixed in cement. The over-all volume reduction factor is about 45:1. The drums containing the fixed waste are qualified for final storage.

3101 (INIS-mf—11045, pp 475-492) **Treatment of solid radioactive wastes by EDF.** Jeanson, P. (EDF Nuclear and Fossil Generation Environment, France). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

After a brief review of the French nuclear program for electric generation, the paper presents the different types of wastes and the conditioning methods used in the power plants. The prospects about conditioning methods are discussed. A general idea is given about national management of radioactive wastes and the procedure to be followed to get, for each type of waste, an approval for disposal on the national disposal center.

3102 (INIS-mf—11045, pp 591-598) **Improvement program of radwaste treatment at Chinshan nuclear power station.** Lin, M.M.H.; Huang, C.Y. (Nuclear Operation Department, Taiwan Power Company, Taiwan; First, CHINSHAN Nuclear Power Station, Taiwan). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Chinshan-1 and 2, the twin 636-megawatt boiling water reactors with independent radwaste treatment facilities, located at northern Taiwan, started power generation in 1977 and 1978, respectively. Initial years of operation of CSNPS indicated a need for improvement of the radwaste scheme originally provided. The major betterment programs for radwaste system include: (1) addition of auxiliary demineralization system and addition resin storage tank/demineralizer, (2) addition of dry laundry and miscellant drain system, (3) addition of off-gas charcoal delay system, (4) tie connection of the liquid waste system of unit 1 and 2, (5) solid waste system retrofit study, (6) volume reduction study. The administration and water quality controls have also been much improved and the discharge of radioactivity is considerably lower after the improvement has been implemented.

3103 (INIS-mf—11045, pp 599-606) **Operational experiences in the treatment of low- and medium-level radwaste in the Federal Republic of Germany.** Lindow, W.; Herbrechter, D.; Stegmaier, W. (Kraftanlagen A.G., Heidelberg, Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Most of the activity in liquid waste in the Federal Republic of Germany as elsewhere arises from nuclear fuel reprocessing. Whereas high level liquid waste is collected and stored in special tanks since 1966, aqueous medium and low level liquid waste is segregated by evaporation, ion exchange and precipitation into an essentially inactive part discharged to the municipal sewage system and a concentrated part, containing salt and activity, which is incorporated either in bitumen or cement for final disposal. Intermediate storage of the solidified waste is practised for the time being in huge storage buildings. All solidified waste is monitored and pertinent data computer-assisted implemented so that the inventory is well-known at any time. Some 30,000m/sup 3/ of primary solid waste are annually, depending on their nature, either incinerated or compacted with subsequent fixation by cement or treated individually. Individual treatment includes electro-chemical decontamination to back-ground activity or plasma-arc cutting to pieces to reduce bulkiness.

3104 (INIS-mf—11045, pp 163-181) **Feasibility of disused underground mines for low level and intermediate level radioactive waste disposal.** Brewitz, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Among the various concepts for geological disposal of radioactive waste the use of underground mines and cavities is being highly accepted by the IAEA member countries in particular for low and intermediate level waste. The technical possibilities of existing or disused mines are manifold and depend directly on quantities, nuclide inventories and conditioning of the waste types to be disposed of. In the Federal Republic of Germany the disused rock salt mine ASSE near Braunschweig owned by GSF was chosen in 1964 to become the nations first and only pilot facility for radioactive waste disposal. From 1967 till 1978 about 125.000 200 1 and 400 1 drums of LLW were emplaced in existing mining chambers by using either stacking or dumping techniques. About 1300 drums of ILW have been disposed of by using transport casks and remote handling techniques for radiation protection. Today the ASSE mine is a research and testing site for the development of disposal techniques for high-level waste. The disused iron ore mine KONRAD at Salzgitter was investigated by GSF for its feasibility for non-heat generating radioactive waste disposal. From 1975 till 1982 various geological, hydrogeological, seismic and rock mechanical investigations were performed and specific technical concepts for waste disposal in underground galleries were developed. After the overall feasibility was proved the Physikalisch-Technische Bundesanstalt (PTB) took over and applied for licencing with the appropriate authorities in accordance with the National Atomic Act. It is expected that after licensing in 1987 and two years of construction the disposal operation may start in 1989.

3105 (INIS-mf—11045, pp 393-404) **Development of a metallic high integrity container.** Haelsig, R.T. (Nuclear Packaging Corp., Federal Way, WA, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Nuclear Packaging, a Pacific Nuclear Company, developed a metallic high integrity container (HIC) for the burial of low level radioactive waste. This class of container has received the most extensive review of any burial container licensed in the United States. It is also the first container that has been licensed to meet the requirements of Nuclear Regulatory Commission Regulations 10CFR61. The design and subsequent review considered 300 years corrosion at a depth of 55 feet with no degradation of container structural integrity. The design also included a technical requirement that the container possess a positive vent that would exclude moisture. The alloy that was selected, allows for significant flexibility in container size and configuration which is essential to accommodating the various waste forms. This allowed the development of containers in various sizes and with a variety of closures, that accommodate the internal dimensions of various shipping shields and help minimize radiation exposure during packaging operations. The material used in the metallic container is high corrosion resistant which reduces the need for strict chemical controls at the waste generating facility. This acts to ease the operational requirements in the treatment of several waste streams. The design result is a family of metallic High Integrity Containers (HIC)s that meet all the performance criteria imposed by the regulations, as well as provide a disposable waste container with good transportation efficiency and minimum operational constraints.

3106 (INIS-mf—11045, pp 435-460) **Design criteria for experimental radioactive waste disposal trenches at the Vaalputs radioactive waste disposal facility.** Hambleton-Jones, B.B.; Moore, P.E. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The development of four experimental trenches at Vaalputs was a multifaceted project designed to obtain site specific data on different variables that ultimately would be used in the construction of the final disposal trenches. The following factors were addressed: evaluation of excavation machinery, detailed geology, engineering geology of the excavation, suitability of excavated material for backfilling and capping, characterization of backfilling and capping methods, natural rehabilitation of soil moisture, corrosion of the drums, and the rehabilitation of the natural vegetation on denuded areas. Backfilling procedures were designed to determine the strengths of the materials placed in the trenches. Three of the trenches were backfilled and capped whereas the fourth was left open so that the stability of the sidewalls being exposed to the atmosphere could be monitored in the long term. The caps consisted of simple and complex types, both of which were designed to limit the infiltration of surface water which in the long term may adversely affect the integrity of the radioactive waste. The simple cap consisted of 2m of clayey grit compacted to a bulk density of about 1 800kg.m/sup -3/. The complex cap contained, in addition, a 250mm thick gravel layer designed to create a wick effect. Aluminium neutron tubes were installed in all the trenches in order to monitor the rate of moisture rehabilitation and also the percolation rate of surface water through the cap. Data collected from the experimental trenches have assisted in the design of the final disposal trenches at Vaalputs.

3107 (INIS-mf—11045, pp 461-474) **Safety assessment of a projected waste repository for HLW during its operational phase.** Jacobi, A. (Swiss Federal Institute of Technology, Zurich, Switzerland). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Based on the repository concept for high level radioactive wastes (HLW) developed in Switzerland, a thorough safety assessment was performed for the repository's operational phase. The approach used is described and the results obtained are given in this paper. There were three starting points for this safety assessment, e.g.: analysis of the operations in the facility, with the aim to identify the potential for accidents which could lead to radioactivity releases; investigation of natural phenomena and other possible initiating events with repository-external origin, to determine their likely effects on the facility; study even of either hypothetical or unrealistic accident scenarios, giving an indication on the repository concept's capability to mitigate the consequences of such extreme situations.

3108 (INIS-mf—11045, pp 493-501) **Operating considerations of shallow land disposal.** Jones, D.F. (Pacific Nuclear Systems, Inc., Washington, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Shallow land burial (SLB) is a widely used and accepted technique for disposal of low level radioactive wastes. In the United States, such activities are governed by U.S. Nuclear Regulatory Commission Regulations (10CFR61). Operating a shallow land burial facility is a complex process requiring concurrent and consistent management emphasis over a broad spectrum of interrelated activities. The degree of emphasis required by some of these activities is predetermined by rigid external influences. Prevailing natural conditions and characteristics of the site as well as state and federal regulations are basic, direct and inescapable influences on site operation. Having a comprehensive set of outstanding operating procedures does not insure that things will be done correctly or even done at all. As in most operations, the overpowering consideration, in operating the disposal site, is the skills and qualifications of both management and operating personnel. Consequently, the most critical factors in the administration of a safe and effective disposal operation is the viable recruitment, selection and training of personnel. Ultimately, the degree of success depends upon the training process.

3109 (INIS-mf—11045, pp 607-614) **Metamict minerals as model substances for radwaste.** Mueller, H. (Institute of Inorganic and Analytical Chemistry, Section Radiochemistry, Freiburg, Federal Republic of Germany). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Metamict minerals have been investigated by thermoanalytical and x-ray methods. Recrystallization temperatures were determined quantitatively, and some further information about the heat release and the newly obtained phases were obtained.

3110 (INIS-mf—11045, pp 665-691) **Design and performance of a low-cost, soil cement cap for LLNW disposal trenches.** Nowatzki, E.A. (Arizona Univ., Tucson, USA. Dept. of Civil Engineering and Engineering Mechanics). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Over the past three years, the University of Arizona has conducted research for the U.S. Nuclear Regulatory Commission (USNRC) to assess various trench cap designs from the viewpoint of structural stability, water infiltration, and economy. As part of that project, four experimental trenches were built and monitored at each of two semi-arid sites in the vicinity of Tucson, Arizona. In this paper, the design and construction of one of those trenches are described in detail. That trench included a cap-crown system that incorporates compacted soil backfill and a steel-reinforced, soil-cement cap with an overlying 'wick' drain. The results of structural monitoring over a period of approximately 2 years are presented and compared to those of a more conventionally designed trench. The results are evaluated with respect to surface subsidence and movements of the cap-crown components as they affect moisture infiltration. Recommendations are made regarding standard design criteria for LLNW disposal trenches based on the results of this research.

3111 (INIS-mf—11045, pp 851-878) **Radioactive waste disposal: solutions pursued in South Africa by ESCOM.** Spencer, P.H.; Roehm, H.F.; Harris, M.I.J. (Electricity Supply Commission, Johannesburg, South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

By producing nuclear power from the 1844 MWe Koeberg power station, the Electricity Supply Commission (ESCOM) became South Africa's largest producer of radioactive waste. In preparing for this eventuality, ESCOM and the Atomic Energy Corporation (AEC) studied the requirements, after which the AEC agreed to embark on establishing a national radioactive waste repository for the safe disposal of Koeberg's waste. This work culminated in the establishment of the national radioactive waste disposal facility at Vaalputs situated in the Northern Cape. At the same time ESCOM began the evaluation of the possible intermediate steps required to ensure the safe and cost-effective storage and disposal of high-level waste from Koeberg. This paper describes and discusses achievements, work underway, and future plans for storage, transportation and disposal of low-level waste, intermediate-level waste, spent fuel and high-level waste from the Koeberg nuclear power station.

3112 (INIS-mf—11045, pp 879-898) **Geotechnical aspects of trench capping.** Stephenson, D.; Moore, P.E.; Hambleton-Jones, B.B. (University of the Witwatersrand, Johannesburg, South Africa; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The trenches for burying radwaste drums at Vaalputs have been designed to minimise the possibility of the penetration by moisture from the surface. Selection of trench cross section and side fill as well as the capping has been based on assuring a low permeability. Laboratory tests and field tests were conducted on soil samples at different compactions to achieve an optimum compromise between permeability and moisture retentivity. A deflection analysis of the capping was performed to check for slumping or cracking of the capping due to settlement of the underlying fill material. The numerical analysis indicated the best trench cap shape.

3113 (INIS-mf—11045, pp 899-913) **Safety assessment for radwaste disposal in Korea: Pt. 1. Development of a code for simplified safety analysis.** Suh, I.S.; Park, H.H.; Han, K.W.; Hahn, P.S. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

A simplified safety analysis code has been established in order to provide a basic methodology for the preliminary selection of a disposal method. The disposal type selection is prerequisite to meet the requirements of low and intermediate level radwaste management program in Korea. The code covers resaturation and leaching, migration through fracture-porous media transport such that the rock cavern disposal option can be evaluated compared with that of shallow land burial.

3114 (INIS-mf—11045, pp 935-942) **Improvement program of Lan-Yu radwaste receiving and storage facility in Taiwan, ROC.** Tsai, C.M.; Lee, R.T. (Radwaste Administration, Atomic Energy Council, Taipei, Taiwan). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Low level waste generated from three nuclear power plants in Taiwan is stored at Lan-Yu. The storage facility comprises 23 near-surface concrete trenches, inspection center, office building, etc., and is operated by the Radwaste Administration. The construction was completed in January 1982 and has been receiving waste since May 1982. Up to date, about 35,500 drums of solidified waste have been stored in this facility. An improvement program for the existing receiving and storage operation at Lan-Yu facility began in 1984 by the Radwaste Administration. The first step in this effort will be to install a semi-automatic inspection line in the inspection center and a remote-controlled unloading equipment for the storage operation. The new installation will enhance the efficiency and reduce exposure to inspectors. Detailed engineering design was already completed in January 1985. The installation will be completed in February 1987. The second step will be to develop an upgraded design for the second phase construction of the facility. The intent of this design change based on the ALARA concept is to reduce the exposure to workers and at the same time preserve the landscape. Thus, the new design will incorporate remote handling, minimizing exposure to workers and landscaping at the storage area. The concept design was completed in August 1986.

3115 (INIS-mf—11045, pp 963-982) **Radioactive waste disposal in South Africa.** Van der Westhuizen, H.J.; Moore, P.E. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The South African policy on radioactive waste management is outlined. The State is responsible for providing off-site storage and disposal facilities for radioactive waste and spent fuel. Such activities are controlled by the Licensing Branch of the Atomic Energy Corporation in accordance with the appropriate legislation. The amounts of radwaste produced are given. The waste disposal practices at Pelindaba, and the proposed practices at the Vaalputs radioactive waste disposal facility are described. Details of the planning, design considerations (including activity inventory), and construction of Vaalputs are given. Vaalputs is considered to be an ideal site for radioactive waste disposal and it admirably satisfies recognized site selection criteria. The construction of the buildings at Vaalputs is almost complete and the facility is scheduled to accept waste from Koeberg Nuclear Power Station in November 1986.

3116 (INIS-mf—11046, pp 44) **Gamma-ray dose rates resulting from the reracking of the Koeberg spent fuel into high density storage racks.** Sartori, D.E.; De Luca, G. (Atomic Energy Corp. of South Africa, Pty Ltd., Pretoria; Electricity Supply Commission, Johannesburg, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

3117 **(IPEN-Pub—112) Contribution of IPEN-CNEN/SP to the Seminar on Management Options for Low and Intermediate Level Wastes in Latin America.** (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. 134p. (CONF-861065—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700437/JAW.

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

The solutions adopted for management problems and radioactive wastes of nuclear installations and contamined materials generated in hospitals, research centers, laboratories in the countries of Latin America are presented. The criteria of site selection for radioactive waste installation and the methods for treating and storage are evaluated the results of inspections in installations which handle radioactive wastes are done (M.C.K.).

3118 (IPEN-Pub—112, pp 127) **Conditioning liquid waste from I/sup 131/ production by natural TeO/sub 2/ neutron irradiation.** Dalaqua Junior, L.; Dellamano, J.C. Jul 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700437/JAW. (CONF-861065—).

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

This paper describes the treatment techniques assayed to decontamination and volume reduction of the waste from I-131 production. The assayed techniques were: (NH/sub 4/)/sub 2/ TeO/sub 4/ precipitation in alcoolic medium and chemical reduction using Sn/sup 2+/in acid medium and Fe/sup 2+/in al alkaline medium. There is some considerations about products features and final results.

3119 **(JAERI-M—87-033) Evaluation of deconstruction behavior of high-level radioactive waste glass.** Takeda, Tsuneo; Nakamura, Haruo; Niwa, Kunikazu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1987. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700060/JAW.

The evaluation of deconstruction behavior of high-level radioactive waste (HLW) glass caused by drop impact and thermal impact is one of the most important items in safety analysis of HLW handling facilities. To evaluate the deconstruction behavior, a new calculation method is necessary. Therefore, a computer code ADEKAT-G has been developed by using a rigid-body spring model. In this paper, results estimated by ADEKAT-G are summarized in the following problems; (1) Thermal impact under a condition of cooling after vitrification, (2) 9 m free drop in a vertical position on a flat floor, (3) Effects on drop height (0.5 m to 9 m), (4) Free drop on a head of another HLW canister settled in a pit and (5) Corner drop on a flat floor.

3120 **(K/QT—105) Bench-scale study of direct calcination of raffinate waste.** Bundy, R.D.; Alderfer, R.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Sep 1987. Contract AC05-84OT21400. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000646/JAW.

Bench-scale tests of the direct calcination process for Portsmouth were conducted using batch pot calcination of simulated and actual raffinate wastes. These studies included investigation of the evaporation step needed to concentrate the raffinate before calcination. Tests were conducted at calcination temperatures of 600, 700, 1000, and 1200°F with two levels of evaporative concentration before calcination at 1000°F. Evaporation only tests were also made. Performance of the bench-scale system was excellent. A calcination temperature of 715°F indicated that 80 to 100% of the Tc was retained in the calcined solids, while all of the nitrates were decomposed to oxides. With calcination temperatures of ≧ 1000°F, part of the Tc escaped from the calcination pot to the scrubber. Below 700°F, not all of the nitrates were decomposed to oxides. Most of the U remained in the calcined solids for calcination temperatures of ≦ 1000°F. The mass of solids remaining after calcination was 4 to 5% of the original raffinate for calcination temperatures from 700 to 1000°F. Flow rate through the off-gas treatment system was variable. The water scrubber had a good removal efficiency for nitrate and most metals, but not for uranium. The trapping efficiency of the limestone trap for nitrate was low. Flowsheet studies indicate that enough U would pass through the scrubber and chemical traps to cause an unacceptably high release of radioactivity if the assay of the uranium exceeded 33%. A small HEPA filter after the limestone chemical traps is recommended to reduce U emissions. A flowsheet was developed for a full-scale process for the direct calcination of raffinate waste.

3121 **(KFK—4244) Investigations on the suitability of ceramic containers for corrosion protection of high-level waste forms during disposal in rock salt formations.** Smailos, E.; Schwarzkopf, W.; Koester, R.; Storch, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Apr 1987. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750022/JAW.

The suitability has been studied of ceramic containers to serve as long-term corrosion protection for HLW forms under hypothetical accident conditions in a rock salt repository. For this purpose the corrosion behaviour of selected ceramic materials and diffusion bonded specimens (simulating container lids) have been examined in a salt brine rich in MgCl/sub 2/ (Q-brine). The test temperatures were 80deg60, 160degC and 200degC, the test pressure was 13 MPa, and the test period lasted up to two years. Besides, orientation studies have been performed in order to estimate the feasibility of two basic concepts for disposal packages provided with a ceramic corrosion protection (ceramic as insert or supplementary container). These studies include the thermal shock resistance of technical grade Al/sub 2/O/sub 3/ during HLW glass filling as well as the possibility of closing Al/sub 2/O/sub 3/ containers by glass soldering and overpouring glass, respectively. (orig./IHOE).

3122 **(LA—1521/7) Explanation and summary of the best practicable environmental options (BPEOs) for the management of low- and intermediate-level solid radioactive wastes.** (Large and Associates, London (UK)). Nov 1985. 36p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Report prepared for the National Union of Seamen.

This is a discussion paper considering in general terms the brief, scope and recommendations of the Department of the Environment (DOE) best practicable environmental options study for the management of low-and intermediate-level solid radioactive wastes. The analytical technique used for the DOE Study, Multi-Attributable value Theory, is criticised. Sea-dumping is also proposed by the DOE but not considered suitable by the authors of this assessment. This paper concludes that until it is possible to predict all the health and environmental risks associated with radioactive waste dumping, these wastes should be stored in a retrievable state.

3123 **(LA—11077-MS) Preliminary studies on denitrating evaporator salt waste.** Yarbro, S.L.; Brede, L.J. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001954/JAW.

At the Los Alamos Plutonium Facility, ion exchange effluents are concentrated by evaporation prior to cementing for waste disposal. After evaporation, the concentrated salt solution is filtered, and the filtrate neutralized with sodium hydroxide to prepare it for cementing. This results in an exposure hazard to operating personnel and a large increase in waste volume and salt concentration. A possible solution is to denitrate the waste solution with an appropriate organic compound, thereby vastly reducing the amount of handling and sodium hydroxide required for pH adjustment. Of the three organic compounds that were examined, formic acid appears to be best suited for this particular use, because it had a reasonable denitration rate, is relatively easy to handle, and has only a small volume increase after reaction.

3124 **(LA—11097-MS) Controlled blasting and its implications for the NNWSI project exploratory shaft.** Van Eeckhout, E.M. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000173/JAW.

This report reviews controlled blasting techniques for shaft sinking. Presplitting and smooth blasting are the techniques of principal interest. Smooth blasting is preferred for the Nevada Nuclear Waste Storage Investigations exploratory shaft. Shaft damage can be monitored visually or by peak velocity measurements and refractive techniques. Damage into the rock should be limited to 3 ft. 40 refs., 22 figs., 7 tabs.

3125 **(LBL—21808) Cumulative releases of radionuclides from uncontained waste packages.** Lee, W.W.L.; Kim, C.L.; Chambre, P.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jul 1986. Contract AC03-76SF00098. 8p. (UCB-NE—4086; CONF-861102—50). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000467/JAW.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

This report describes mathematical predictions for the migration of radionuclides from an emplaced radioactive waste container. The model assumes a spherical-equivalent waste solid surrounded by backfill but neglects the effect of decay heat. 7 refs., 2 tabs. (TEM)

3126 **(LBL—21809) Radionuclide transport through penetrations in nuclear waste containers.** Chambre, P.L.; Lee, W.W.L.; Kim, C.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jul 1986. Contract AC03-76SF00098. 8p. (UCB-NE—4087; CONF-861102—51). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000468/JAW.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Penetrations may result from corrosion or cracking and may be through the container material or through deposits of corrosion products. The analysis deals with the resultant radionuclide transport, but not with how these penetrations occur. We provide numerical illustrations for diffusive nuclide flux through these apertures from mathematical expressions. 2 refs., 2 figs.

3127 **(LBL—23640) Waste dissolution with chemical reaction, diffusion and advection.** Chambre, P.L.; Kang, C.H.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 7p. (CONF-871101—56; UCB-NE—4104). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014115/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This paper extends the mass-transfer analysis to include the effect of advective transport in predicting the steady-state dissolution rate, with a chemical-reaction-rate boundary condition at the surface of a waste form of arbitrary shape. This new theory provides an analytic means of predicting the ground-water velocities at which dissolution rate in a geologic environment will be governed entirely to the chemical reaction rate. As an illustration, we consider the steady-state potential flow of ground water in porous rock surrounding a spherical waste solid. 3 refs., 2 figs.

3128 (NEI-DK—39, pp 108) **Derived limits for I-131 in waste water.** Ennow, K. (National Institute of Radiation Hygiene, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3129 **(NEI-SE—3) Information about the field of nuclear waste 1986.** (KASAM, Consultative Committee for Nuclear Waste Management, Stockholm (Sweden)). 2 Dec 1986. 156p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753367/JAW.

The Consultative Committee for Nuclear Waste Management (KASAM) reports about the knowledge 1986 concerning the management and the ultimate storage of radioactive wastes. In the report discusses ethical aspects, technical and scientific problems related to the radioactive waste disposal. Still there is no plant in the world build for ultimate storage of high-level radioactive wastes, but many states have plans for building such plants. The report gives a survey of different storage technics, chemical, hydrochemical and radioecological problems. Some international and national programs are reviewed. (K.A.E.).

3130 **(NUREG/CR—4954) Long-term performance of spent fuel waste forms.** Means, J.L.; Markworth, A.J.; McCoy, J.K.; Failey, M.P.; Stenhouse, M.J.; Kohli, R.; Taylor, G.C. (Battelle Columbus Div., OH (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Sep 1987. 158p. (BMI—2154). NTIS, PC A08/MF A01 - GPO. Order Number TI88900069/JAW.

This report investigates the leaching/dissolution characteristics of spent fuel in simulated groundwaters. Experiments evaluated the leaching of unirradiated UO_2 in simulated groundwaters both in the presence and absence of an external radiation field. Other experiments characterized the dissolution behavior of spent fuel under the same conditions as for UO_2. Leach data were interpreted in terms of rates and mechanisms of radionuclide release, thus providing insight on leach behavior under realistic repository conditions. Uranium release from both unirradiated and irradiated UO_2 appeared to be solubility controlled, with only minor leachate compositional effects on the uranium concentrations. When leached in the presence of a radiation field, unirradiated UO_2 produced elevated uranium concentrations only in the brine leachates. The leaching of both cesium and iodine from spent fuel was rapid and linear with the surface-area-to-volume (S/V) ratio. Similar to cesium and iodine, strontium release was nearly proportional to S/V. However, unlike cesium and iodine, strontium release was strongly affected by leachate composition, with greater release associated with lower pH. A model describing the kinetics of spent fuel/UO_2 dissolution was developed, complementing the experimental studies. For fixed values of the time constant and kinetic exponent, the model predicts that the effect of water chemistry on spent fuel dissolution is largely limited to affecting the saturation concentration of uranium in the aqueous solution. This result contrasts sharply with results obtained previously for glass dissolution. 59 refs., 34 figs., 13 tabs.

3131 **(NUREG/CR—4995) Experimental assessment of the sealing performance of bentonite borehole plugs.** Sawyer, W.D. II; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Oct 1987. 305p. NTIS, PC A14/MF A01 - GPO. Order Number TI88900154/JAW.

Bentonite, which contains the clay mineral montmorillonite, is being considered as part of a multi-component engineered barrier which will seal geological repositories of high-level radioactive wastes. Four phases of laboratory testing were conducted to quantify bentonite strength and sealing properties. Chemical analysis revealed a wide range of compositions for commercial well-sealing grade bentonites such that bentonite quality control or specifications may be necessary. Reference testing of seven bentonite samples revealed serious testing problems that make bentonite characterization difficult using standard tests. Permeability testing compared the water flow through bentonite to water flow through intact rock. Mechanical testing included direct shear strength and swelling pressure tests. Direct shearing of compacted bentonites revealed that for both unsaturated and saturated test conditions, the bentonite/basalt interface will fail in shear before the intact bentonite plug itself fails. Swelling pressures generated by hydrating bentonites depend upon dry density, mixing and saturating fluid, and method of pressure measurement. Swelling pressures in excess of 1.7 MPa (250 psi) were measured. 163 refs., 72 figs., 42 tabs.

3132 **(ORNL/TM—10141) Summary report on the development of a cement-based formula to immobilize Hanford facility waste.** Gilliam, T.M.; McDaniel, E.W.; Dole, L.R.; Friedman, H.A.; Loflin, J.A.; Mattus, A.J.; Morgan, I.L.; Tallent, O.K.; West, G.A. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001527/JAW.

This report recommends a cement-based grout formula to immobilize Hanford Facility Waste in the Transportable Grout Facility (TGF). Supporting data confirming compliance with all TGF performance criteria are presented. 9 refs., 24 figs., 50 tabs.

3133 **(ORNL/TM—10500) Precipitation and streamflow in the vicinity of West Chestnut Ridge, near Oak Ridge National Laboratory, Oak Ridge, Tennessee (water years 1984-1985).** Huff, D.D.; Frederick, B.J. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001517/JAW.

West Chestnut Ridge near Oak Ridge National Laboratory was originally considered for use as a central waste disposal facility for a wide range of radioactive wastes, although at present, other alternatives for use of the site are being considered. During 1984 and 1985, continuous discharge and precipitation data were collected and have been summarized as daily values. The unit records are available on disk-storage media, compatible with personal computers. For the data reported, 85% of the individual daily discharge records are considered good, which means within 10% of the true value. Only 1.2% have accuracy that is not within 15% and all occurrences resulted from flows in excess of flume capacity or the associated washout of streambanks which allowed flow to bypass measurement. Flow at most sites spans more than three orders of magnitude between high and low instantaneous values. In 1984, computed evapotranspiration was about 52% of precipitation, but in 1985, because of drier conditions, it was 78% of precipitation. It is possible that a net ground-water loss is partially responsible for the high apparent value of evapotranspiration. Based upon the variability in the hydrologic conditions, further data are required to develop a reliable water budget. 3 refs., 1 fig., 21 tabs.

3134 **(ORNL-WS—1071) Sources, hazards and disposal methods for radioactive wastes.** Forsberg, C.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 27p. (CONF-8709145—1-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014781/JAW.

From Radioactive waste management symposium; Baton Rouge, LA, USA (17 Sep 1987).

This brief report contains only viewgraphs from a lecture on radioactive wastes presented as part of the Oak Ridge Associated Universities Traveling Lecture Program. (TEM)

3135 **(PNL—6268) Statistical process control applied to the liquid-fed ceramic melter process.** Pulsipher, B.A.; Kuhn, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000271/JAW.

In this report, an application of control charts to the apparent feed composition of a Liquid-Fed Ceramic Melter (LFCM) is demonstrated by using results from a simulation of the LFCM system. Usual applications of control charts require the assumption of uncorrelated observations over time. This assumption is violated in the LFCM system because of the heels left in tanks from previous batches. Methods for dealing with this problem have been developed to create control charts for individual batches sent to the feed preparation tank (FPT). These control charts are capable of detecting changes in the process average as well as changes in the process variation. All numbers reported in this document were derived from a simulated demonstration of a plausible LFCM system. In practice, site-specific data must be used as input to a simulation tailored to that site. These data directly affect all variance estimates used to develop control charts. 64 refs., 3 figs., 2 tabs.

3136 **(PNL-SA—13812) Model predictions of glass fracturing in canisters during decontamination.** Farnsworth, R.K. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 14p. (CONF-860905—32). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000076/JAW.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

Wet operations induce a series of thermal transients in a glass product. If excessive, these transients can affect glass quality by increasing fracture. An examination of these transients was made by numerically modeling the transient thermal history of the glass in a typical canister cooling and decontamination cycle. Process variables examined in the modeling effort included glass decay heat, canister diameter, decontamination bath temperature, and the use of insulative liners. Results determined the parameters required for minimum impact on glass quality. Results show that insulative liners inside canisters are an effective means of reducing glass fracture during canister cooling and decontamination. Results also show a need for higher quench temperatures with any decrease in canister surface emissivity that may accompany decontamination. Processing options that could minimize this effect are discussed. 5 refs., 1 fig., 7 tabs.

3137 **(PNL-SA—14691) Organic analyses of mixed nuclear wastes.** Toste, A.P.; Lucke, R.B.; Lechner-Fish, T.J.; Hendren, D.J.; Myers, R.B. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 8p. (CONF-870306—65). NTIS, PC A02. Order Number DE88000564/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Analytical methods are being developed for the organic analysis of nuclear wastes. Our laboratory analyzed the organic content of three commercial wastes and an organic-rich, complex concentrate waste. The commercial wastes contained a variety of hydrophobic and hydrophilic organics, at concentrations ranging from nanomolar to micromolar. Alkyl phenols, chelating and complexing agents, as well as their degradation products, and carboxylic acids were detected in the commercial wastes. The complex concentrate waste contained chelating and complexing agents, as well as numerous degradation products, at millimolar concentrations. 75.1% of the complex concentrate waste's total organic carbon content has been identified. The presence of chelator fragments in all of the wastes analyzed, occasionally at elevated concentrations, indicates that organic diagenesis, or degradation, in nuclear wastes is both widespread and quite vigorous. 23 refs., 3 tabs.

3138 **(PNL-SA—14963) US Department of Energy approaches to the assessment of radionuclide migration for the Geologic Repository Program.** Van Luik, A.E.; Apted, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 23p. (CONF-870965—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000083/JAW.

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

Potential radionuclide migration in geologic repositories is being addressed. Geohydrologic settings being investigated include unsaturated tuff, saturated basalt, and bedded salt. Several approaches to assessing potential migration are being considered. Mass transfer is prominent among near-field approaches, involving estimation of diffusive transport rates through the engineered barrier system using analytical and finite element methods. For far-field analysis of migration in the geosphere, detailed characterizations of potential repository sites will lead to site-specific models describing radionuclide migration for a variety of postulated release scenarios. Finite-element and finite-difference codes are being used and developed to solve the mathematical equations pertinent to far-field assessments. Computational approaches presently in use generally require distribution coefficients to estimate the retardation of specific radionuclides with respect to the transport rate of water.

3139 **(PNL-SA—15096) Economic analysis of engineered sorbent barrier technology.** Freeman, H.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 8p. (CONF-870859—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000090/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

This paper evaluates the incremental cost of placing an engineered sorbent barrier beneath a shallow land burial (SLB) site in a humid climate. The cost estimates are also applicable to alternative uses of sorbent barrier technology such as redundant barriers around below-grade vaults. The preliminary costs presented represent only rough order-of-magnitude estimates. Further information obtained from field studies and refined performance models would allow a more precise cost estimate to be prepared. Flow-through column tests have shown that clinoptilolite is much more effective in sorbing strontium than indicated previously. The effectiveness of the barrier for cobalt was not as good as that measured previously. The costs in this paper are based on these updated data. 8 refs., 1 fig., 4 tabs.

3140 **(PTB-SE—14, pp 1-13) Site-specific research work concerning retention of radionuclides in the geosphere.** Warnecke, E. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The PTB is responsible for preparing the documents required for applications for a licence permitting installation and operation of radioactive waste repositories, and as a designated operator of such installation carries out the planning work for two installations in deep geological strata: (1) Planned repository in the Gorleben salt dome, for all types of solid and solidified radioactive waste. (2) Planned repository in the Konrad iron ore mine, for waste with negligible thermal effects on the host rock. In addition, work has been started for investigating the conditions of safe deep underground disposal of tritium-contaminated water. The contribution reports the results of exploratory work so far, and of the study on the water path scenario. Information is presented concerning the sorption behaviour of radionuclides (water sediment) at the planned sites, and points of main interest for further research programmes and accompanying R and D activities.

3141 (PTB-SE—14, pp 14) **Incorporation of Tc into a glass matrix, leaching experiments with Tc-bearing glass, and interaction of TcO/sub 2/ and Tc-bearing compounds with aquatic media.** Kanellakopulos, B.; Mueller, J.; Vida, J.T.; Apostolidis, C.; Kim, J.I.; Klein, F.; Kerber, H.G.; Odoj, R. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie; Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

3142 (PTB-SE—14, pp 28-40) **Leaching of actinides and fission products from ILW embedded in cement and bitumen, and their mobility in natural salt rock.** Flambard, A.R.; Keiling, C.; Fusban, H.U.; Marx, G. (Freie Univ. Berlin, Germany, F.R. Abt. fuer Radiochemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Real and simulated ILW embedded in cement and bitumen has been subjected to leaching through various binary brines. The resulting solutions containing americium, plutonium, cesium, antimony, ruthenium, cobalt, and strontium have been led through columns packed with the natural Na3γ salt rock from the Gorleben salt dome, in order to determine the mobility characteristics of these elements in the near-field range of a projected waste repository in the Gorleben salt dome, specifically for the case of water intrusion. Leaching data and experimental results are explained and discussed, special attention being given to the impact of the pH-value of the systems studied, and to the formation of carrier (or 'pseudo') colloids during radionuclide release. The paper also gives data obtained on the mobility of transuranium elements and fission products, together with information on differences in behaviour of the actinides and the fission products (ruthenium in particular).

3143 (PTB-SE—14, pp 162-172) **Sampling and specimen preparation of rocks from the Asse mine, for sorption studies.** Bode, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Within the framework of siting exploratory work in the Asse salt mine, five deep holes have been brought down, a series of hydrogeological wells (up to a depth of 300 m), and some gauge wells (up to 110 m). Most of the borings are core drills with a diameter of 100 mm. In addition to the usual experiments for rock property determination, samples for the determination of sorption properties have been taken. In order to reduce the effect of the O/sub 2/ in the air on the rocks during storage, the bore kernels have been put into O/sub 2/-tight casks immediately after sampling and cleaning. Processing has been done by means of a jawbreaker, hammer milling, and a shaking device, all equipped with argon-conditioned boxes. The specimens have been shipped in Al-coated and Ar-conditioned polyethylene containers.

3144 (PTB-SE—14, pp 308-314) **Significance of chemical retention effects with regard to long-term safety of a waste repository in salt rock.** Storck, R. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig, Germany, F.R. Inst. fuer Tieflagerung). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Leaching, precipitation beyond the solubility product, and sorption of radionuclides are the chemical criteria to be studied for safety analyses of a radwaste repository. The chemical processes and effects involved are explained and the results are interpreted in terms of radiation doses emanating from a variety of relevant radionuclides.

3145 (PTB-SE—14, pp 315-325) **Derivation of sorption data for site-specific safety analyses.** Tittel, G.; Hollmann, A. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Site-specific safety analyses are made in order to give proof of the radiological safety within the given legally permitted limits, of the planned waste repositories at Gorleben and in the Konrad shaft, and this both with regard to the period of operation and to the time following shut-down and sealing. One approach to this end is computerized modelling of possible radionuclide transport to the biosphere in the given environment through infiltrating waters. The barrier effect of the various overlying rock strata is characterized by element-specific retardation factors representing a measure for the delay of radionuclide migration as compared with the water, as a result of sorption processes. The paper presents a review of experimental sorption data obtained by various study groups at the two sites.

3146 (SAND—84-7213) **Interaction of nuclear waste panels with shafts and access ramps for a potential repository at Yucca Mountain: Nevada Nuclear Waste Storage Investigations Project.** St. John, C.M. (Agbabian Associates, El Segundo, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000269/JAW.

A series of two-dimensional and three-dimensional analyses of a potential nuclear waste repository at Yucca Mountain were performed to estimate the thermal stresses that would be experienced at the possible locations of shafts or ramps providing access to the repository horizon. Two alternative assumptions were made for the initial state of stress, and calculations were performed to investigate behavior at repository scale. The computed states of stress were also used as boundary conditions for a series of analyses of the access ramps and vertical shafts. The results of the repository scale analyses indicated that there is a region above the repository horizon where the horizontal stresses are reduced as a consequence of the thermal loads imposed by waste emplacement. If the initial state of stress is relatively low then the total horizontal stresses near the ground surface above the repository may be tensile. An evaluation of the total stress state relative to the strength of the rock matrix and vertical and near vertical joints indicates that there is no potential for development of new fractures in the matrix, but joints near the surface could be activated if the initial stress state is low. 13 refs., 24 figs., 4 tabs.

3147 (SAND—85-0762) **Bulk, thermal, and mechanical properties of the Topopah Spring Member of the Paintbrush Tuff, Yucca Mountain, Nevada.** Nimick, F.B.; Schwartz, B.M. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 253p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001318/JAW.

Experimental data on matrix porosity, grain density, thermal expansion, compressive strength, Young's modulus, Poisson's ratio, and axial strain at failure for samples from the Topopah Spring Member of the Paintbrush Tuff are compiled. Heat capacity and emissivity also are discussed. Data have been analyzed for spatial variability; slight variability is observed for matrix porosity, grain density, and thermal expansion coefficient. Estimates of in situ values for some properties, such as bulk density and heat capacity, are presented. Vertical in situ stress as a function of horizontal and vertical location has been calculated. 96 refs., 37 figs., 27 tabs.

3148 **(SAND—86-1031) The data acquisition system for the Waste Isolation Pilot Plant in situ tests.** McIlmoyle, J.T.; Matalucci, R.V.; Ogden, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000268/JAW.

The in situ tests associated with the Waste Isolation Pilot Plant in southeastern New Mexico address technical issues of thermal/structural interaction, waste package performance, and plugging and sealing. Data from these tests are collected by a data acquisition system (DAS) consisting of two distinct locations, above ground and underground that use the IEEE-488 bus for communication. Approximately 5000 data channels are recorded every 4 hours from extensometers, stressmeters, thermocouples, closure gages, and other special gages. Data from these in situ tests are used to verify laboratory and theoretical studies in nuclear waste technology that have been ongoing since the late 1970s and to acquire the necessary information to allow changes to the physical models that may be indicated by the results. 8 refs., 14 figs., 3 tabs.

3149 **(SAND—87-0265) The effects of a bimodal pore distribution on matrix diffusion in a fractured porous medium.** Tomasko, D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000258/JAW.

Three models are developed for predicting the concentration of a conservative (nonreactive) solute during transport through a fractured porous medium consisting of two materials with different physical properties. The materials are assumed to be arranged in series along the fracture, so that the advecting fluid sequentially passes through two different matrix environments. In all cases, the matrices are assumed to be infinite in a direction perpendicular to the orientation of the fracture. The first model predicts the time-dependent solute concentration using two one-dimensional transport equations for the fracture and two one-dimensional diffusion equations for the rock matrices. Longitudinal dispersion in the fracture is assumed to be negligible. The fracture equations are coupled by assuming a constant concentration at the boundary between the two materials, and the fractures are coupled to the matrices by appropriate flux terms. In the second model, the number of equations required to predict the concentration of the solute in the fracture is reduced by a factor of 2 by developing simple, analytic expressions for a single, effective porosity and matrix-diffusion coefficient. The third model incorporates longtitudinal dispersion in the fracture transport equations. This model was developed and used to investigate the effects of axial dispersion on the predicted concentrations and to determine when the simpler models are appropriate. Comprisons between the three models indicate that the predicted solute concentrations in a fracture for a constant source input are very similar except near the boundary between the two materials, where the maximum differences are ~20%. Even better results are obtained when the duration of the injection is short compared to the total time of the test. 32 refs., 18 figs., 2 tabs.

3150 **(SAND—87-0685C) Parameter sensitivity and importance for radionuclide transport in double-porosity systems.** Tomasko, D.; Reeves, M.; Kelley, V.A.; Pickens, J.F. (Sandia National Labs., Albuquerque, NM (USA); Intera Technologies, Inc., Austin, TX (USA)). 1987. Contract AC04-76DP00789. 37p. (CONF-870971—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87013938/JAW.

From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA (15 Sep 1987).

A type-curve methodology using four dimensionless parameters is developed for modeling radionuclide transport through a fractured, double-porosity system. A dimensionless velocity and a dimensionless dispersion coefficient characterize transport through the fractures, while a dimensionless solute storage enhancement coefficient and a dimensionless time constant for matrix diffusion characterize the coupling of the matrix to the fractures. Using the dimensionless parameters, parameter-variation curves exhibit the general response of a performance measure, nuclide travel time, with respect to the entire range of parameter variability. Parameter sensitivities are then calculated as the normalized derivatives of the parameter-variation curves for the dimensionless set of base-case values. Parameter sensitivities are recast to find the response of the performance measure in terms of a natural set of dimensional parameters that characterize the double-porosity transport model. Importance coefficients are defined to ascertain the relative ranking of the natural set of base-case parameters. 15 refs., 15 figs., 6 tabs.

3151 **(SAND—87-1202C) Risk assessment for subseabed disposal of high level radioactive waste.** Klett, R.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-8709150—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013712/JAW.

From 7. international ocean disposal symposium; Halifax, Canada (21 Sep 1987).

Feasibility studies for subseabed high-level waste (HLW) disposal required development of new evaluation standards, performance assessment procedures, and models. The steps for the Subseabed Disposal Project (SDP) risk assessment are interactive as the design develops and the models and data base become more complete. The reference system (including transportation, emplacement, the operating repository, and possible abnormal events) is defined. Since no official radiological protection criteria exist for subseabed HLW disposal, evaluation standards are defined. Analytic and compartmental models are developed for sensitivity and repetitive risk analyses. These fast and convenient computer models are verified with numeric programs. Analysis begins with parametric studies to define the senitivity of each input parameter. This is followed by an attenuation factor analysis to define the effectiveness of each component, and the robustness and limitations of the system. Peak individual, time integrated world population, and biota doses are computed using reference parameters.

3152 **(SAND—87-2136C) A repository view of the system.** Hunter, T.O. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 19p. (CONF-870948—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013711/JAW.

From American Nuclear Society topical meeting on the integrated spent fuel and HLW management system; Albuquerque, NM, USA (27 Sep 1987).

A nuclear waste repository will not receive a single, well-defined waste type from one source. The current operating design basis of 3400 MTU or equivalent annual receipt rate and 70,000 total disposal capacity places unique requirements on the transportation-repository interface at the repository. With a 70/30 truck/rail mix (by mass) approximately 2300 truck and 140 rail casks would arrive annually. Some 10,000 fuel assemblies would be processed annually by the repository surface facility and 2000 emplacement containers of spent fuel and high-level waste prepared for disposal. If spent fuel consolidation is performed at the repository, the requirements on the surface facility will be especially demanding. If spent fuel is consolidated or pre-packaged at the MRS, there will be a major impact on the specification of the transportation-repository interface. Current designs must allow for spent fuel burnups up to 60,000 MWd/MTU, spent fuel age (time from discharge) as small as 5 years, and commensurately high thermal power and radiation levels. This wide range of potential interface conditions can be accommodated in the conduct of repository design; however, early resolution of major decisions regarding the role of the MRS, the need for at-repository spent fuel consolidation, and more detailed specification of waste characteristics would allow a more cost effective and timely design to be achieved. 10 refs., 6 figs., 6 tabs.

3153 **(SKB-TR—86-06) Geological and tectonic description of the Klipperaas study site.** Olkiewicz, A.; Stejskal, V. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Oct 1986. 136p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753364/JAW.

The Klipperaas study site is situated 45 km WNW of Kalmar in south-eastern Sweden. The site is situated between two regional NW-SE oriented lineaments. The site itself does not show any distinct lineaments. The site is flat, covered by till and with few outcrops. The precambrian rocks of this area are thought to be postor-

ogenic in relation to the svecokarelien orogeny. The bedrock consists of 85 percent granites, 7 percent greenstones, 5.5 percent porphyries, 1.5 percent mafic dykes and 1 percent aplites. The granites are normally grey-red, medium grained and massive. They are, in a tectonically undisturbed condition, strongly magnetic. Closely associated with the granites are aplite dykes. The greenstones are schistos and present a number of originally different rocks. Some of them are xenolithes, others are dykes. The latter are often associated with dyke porphyries in composite dykes. The dyke porphyries have variable chemical compositions. Their width is usually 10 m and the directions group between W-WNW. The youngest rocks comprise a number of different, rather wellpreserved mafic dykes. Their width varies form ca 1 m to 10 m. The geophysical surface measurements display many discontinuities of variable intensity. They are oriented in two main directions,N-S and NE-SW. The dip of the fracture zones and the dykes vary from steep to 75 degrees. The horizontal fracture zone at the depth of 780 m is an exception. The widest investigated fracture zone has a width if 30 m. (authors).

3154 **(TP—1182) Aeration period of a model nuclear waste repository.** Sharland, S.M.; Tasker, P.W. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Feb 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750122/JAW.

We have constructed a model of the evolution of oxygen in a cement backfill which includes both its depletion through the canister corrosion reactions and its migration in the cement pores. The results indicate that the duration in which mild stee! waste canisters may be subject to localised corrosion is very much shorter than the intended lifetime of the repository components, provided there is no external source of oxygen. For canisters spaced 1.2m apart, the model predicts a maximum aeration period of approximately 65 years, assuming high oxygen content and diffusivity in the backfill and low leakage current on the canisters (0.01 $\mu A\ cm^{-2}$). In such a case a reducing environment is established throughout the backfill within this period. Under conditions of more restricted oxygen transport, reducing conditions are still established within a relatively short time in the immediate vicinity of the canisters, but the oxidation potential elsewhere in the backfill is then controlled by the uniform corrosion rate of the canisters.

3155 **(TVA/PUB—88/2) Radiological impact assessment report: Browns Ferry Nuclear Plant, January through June 1987.** Nicoll, R. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Nuclear Services). 14 Aug 1987. 48p. NTIS, PC A03/MF A01. Order Number DE88900007/JAW.

Potential doses to individuals and populations have been calculated for the time period January through June, 1987. Measured plant releases for the reporting period are used as input in the Gaseous Effluent Licensing Code for gaseous releases and the Quarterly Water Assessment Code for liquid releases to estimate dose. Dispersion of radioactive effluents in the environment has been calculated using meteorological data and riverflow data measured during this period. 5 figs., 15 tabs.

3156 **(UCID—20967) Scientific investigation plan for NNWSI WBS element 1.2.2.5.L: NNWSI waste package performance assessment: Revision 1.** Eggert, K.G.; O'Connell, W.J.; Lappa, D.A. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1986. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88000688/JAW.

Waste package performance assessment contains three broad categories of activities. These activities are: (1) development of a hydrothermal flow and transport model to test concepts to be used in establishing boundary conditions for performance calculations, and to interface EBS release calculations with total system performance calculations; (2) development of a waste package systems model to provide integrated deterministic assessments of performance and analyses of waste package designs; and (3) development of an uncertainty methodology for combination with the system model to perform probabilistic reliability and performance analysis waste package designs. The first category contains activities that aid in determining the scope of a separate, simplified set of hydrologic calculations needed to characterize the waste package environment for performance assessment calculations. The last two activity categories are directly concerned with waste package performance calculations. A rationale for each activity under these groups is presented. All of the activities of performance assessment are either code development or analyses of waste package problems.

3157 **(UCRL—53767) Geomechanics of the Spent Fuel Test: Climax.** Wilder, D.G.; Yow, J.L. Jr. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000676/JAW.

Three years of geomechanical measurements were made at the Spent Fuel Test-Climax (SFT-C) 1400 feet underground in fractured granitic rock. Heating of the rock mass resulted from emplacement of spent fuel as well as the heating by electrical heaters. Cooldown of the rock occurred after the spent fuel was removed and the heaters were turned off. The measurements program examines both gross and localized responses of the rock mass to thermal loading, to evaluate the thermomechanical response of sheared and fractured rock with that of relatively unfractured rock, to compare the magnitudes of displacements during mining with those induced by extensive heating of the rock mass, and to check assumptions regarding symmetry and damaged zones made in numerical modeling of the SFT-C. 28 refs., 113 figs., 10 tabs.

3158 **(YJT—87-07) Validation of a numerical release model (REPCOM) for the Finnish reactor waste disposal systems: Pt. 1. Start-up of the laboratory experiments.** Nykyri, M. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). May 1987. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753054/JAW.

The aim of the work is to model experimentally the inner structures and materials of two reactor waste repositories and to use the results for the validation work of a numerical near field release model, REPCOM. The experimental modelling of the multibarrier systems is conducted on a laboratory scale by using the same principal materials as are employed in the Finnish reactor waste disposal concepts. The migration of radionuclides is studied in two or more consecutive material layers. The laboratory arrangements include the following test materials: bituminized resin, cemented resin, concrete, crushed rock, and water. The materials correspond to the local materials in the planned disposal systems. Cs-137, Co-60, Sr-85, and Sr-90 are used as tracers, with which the resin, water, and crushed rock are labeled depending on the specimen type. The basic specimen geometries are cylindrical and cubic. In the cylindrical geometry the test materials were placed into PVC-tubes. The corresponding numerical model is one-dimensional. In the cubic geometry the materials were placed inside each other. The boundaries form cubes, and the numerical model is three-dimensional. Altogether 12 test system types were produced. The gamma active nuclides in the cylindrical samples were measured nondestructively with a scanner in order to determine the activity profiles in the specimens. The gamma active nuclides in the cubic samples and the beta emeitting Sr-90 in separate samples will be measured after splitting the samples. One to five activity profiles were determined for each cylindrical gamma-active sample. There are already clear diffusion profiles to be had for strontium in crushed rock, and for cesium in crushed rock and in concrete. Cobalt indicated no diffusion. No activity profiles were measured for the cubic samples or for the beta active, Sr-90-doped samples.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 2932, 2937, 2975, 2976, 2988, 2991, 3018, 3022, 3046, 3047, 3048, 3049, 3050, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 3058, 3059, 3060, 3061, 3062, 3063, 3064, 3065, 3066, 3068, 3069, 3124, 3125, 3126, 3127, 3130, 3131, 3132, 3133, 3134, 3135, 3136, 3138, 3139, 3146, 3147, 3148, 3149, 3150, 3151, 3152, 3155, 3157, 3158, 3463, 3465, 3717, 3834, 4325, 4419, 4420, 4568

3159 (CONF-860990—Pt.2, pp 55-59) **Reclamation of a uraniferous lignite mine, North Dakota: summary paper.** Houghton, R.L.; Hall, R.L.; Unseth, J.D.; Wald, J.D.; Burgess, J.L.; Patrick, D.P.; Anderson, G.S.; Hill, S.R. (Geological Survey, Bismarck, ND). Feb 1987. NTIS, PC A05/MF A01. Order Number DE87012443/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Uraniferous lignite deposits were mined from 1955 to 1967 by surface mining techniques. Overburden was stripped, and the lignite was burned to concentrate the uranium in its ash. Uranium salts in the overburden gave exposure levels of as much as 500 microroentgens/hour; water in mine pits had U concentrations from 12 to 19,000 micrograms/liter. Reclamation involved replacing the spoils into the source pit, the most contaminated spoils being placed above the water table, capping the pit with clay then topsoil containing lesser concentrations of radioactive elements, and finally planting with prairie grass. Resulting concentrations of radionuclides are given. The land is expected to remain as prairie for wildlife use, but it is safe enough for domestic animals as well. 3 figures.

3160 (PB—87-226767/XAB) **Ground-water protection standards for inactive uranium-tailings sites: background information for proposed rule. Final report.** (Office of Radiation Programs, Washington, DC (USA)). Jul 1987. 266p. (EPA—520/1-87/014). NTIS, PC A12/MF A01.

The report summarizes the information and data considered by EPA in developing the proposed ground-water protection standards. It gives a description of the 24 designated uranium tailings sites and their current status in the DOE remedial action program. It also presents a detailed analysis of the available data on the ground water in the vicinity of 12 of the 24 sites and describes different methods that can be used for the restoration of ground water.

0540 Health And Safety

REFER ALSO TO CITATION(S) 2955, 2979, 2980, 2981, 3144, 3175, 3465, 3672, 3834, 4513

3161 (AERE-R—12474) **Survey of strippable and tie-down coatings for use in the decommissioning of alpha-active facilities.** Turner, A.D.; Worrall, G.; Dalton, J.T. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Apr 1987. 39p. (PCMRP—86-P4; DDTF/P—80). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750211/JAW.

The paper concerns temporary coatings for use in decommissioning operations of alpha-active facilities. The various temporary coating options are described with respect to: decontamination by removal of a previously applied protective coating, and the in-situ application of a coating for tie-down or decontamination duties. The specifications for coating systems to be used in active areas are defined in general terms. A survey of currently available temporary coating material is given, as well as the suitability of commercially available coating systems. (U.K.).

3162 (CONF-8704115—Summ., pp 1) **Welcome address for remedial action programs annual meeting.** Little, L.E. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

As a prelude to the meeting the speaker reviews the history of the founding and operation of the Grand Junction Projects Office. During the previous three decades the office was involved primarily in uranium exploration and yellow cake production. Today, because of the office has strength in the geosciences and program management, activities have expanded to include several projects related to remedial action in addition to support for the mining and exploration industry.

3163 (CONF-8704115—Summ., pp 3-5) **Remedial action and waste technology program direction and future.** Voigt, W.R. Jr. 1987. DOE offices and DOE contractors. Order Number TI87028675/JAW.

From Remedial Action Program annual meeting; Grand Junction, CO, USA (27 Apr 1987).

The speaker reviews the history of the concerns which lead to the Remedial Action Program and outlines the challenges facing the program today. The challenges involve public and political interest in the program, funding, and communications. Each of these aspects is briefly discussed.

3164 (NEI-NO—26) **Nuclear accidents. Proposals for national and international measures.** (Miljoeverndepartementet, Oslo (Norway)). 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753035/JAW.

Unofficial translation of "Measures against nuclear accidents, part II" (NOU 1987:13).

On 27 May 1986 the Norwegian government appointed an inter-ministerial committee of senior officials to prepare a report on experiences in connection with the Chernobyl accident. The present second part of the committee's report describes proposals for measures to prevent and deal with similar accidents in the future. The committee's evaluations and proposals are grouped into four main sections: Safety and risk at nuclear power plants; the Norwegian contingency organization for dealing with nuclear accidents; compensation issues; and international cooperation.

3165 (NRPB-GS—8) **Revised generalised derived limits for radioisotopes of strontium, iodine, caesium, plutonium, americium and curium.** Haywood, S.M. (National Radiological Protection Board, Chilton (UK)). Aug 1987. 56p. H.M. Stationery Office, London, price Pound 5.00.

Revised Generalized Derived Limit (GDL) are evaluated for isotopes of strontium, iodine, caesium, plutonium, americium and curium in selected materials from terrestrial and aquatic environments and for discharge to atmosphere. Values presented are intended for use as convenient reference levels against which the results of environmental monitoring can be compared and atmospheric discharges assessed; they replace those in NRPB reports DL5 to DL9. Generalised Derived Limits are calculated for uniform conditions over a year and use deliberately cautious assumptions concerning habits and location of the critical group of exposed individuals in the population and, where appropriate, concerning the conditions of discharge and prevailing weather. If the environmental contamination over a year or discharge to atmosphere exceeds about 25% of the GDL, critical-group doses should be examined more closely, taking account of site-specific factors and the duration of the period of excess.

3166 (SIS—1987:7) **Measurement of 50 Hz magnetic fields in some Norwegian households.** Karlsen, J.; Johnsson, A.; Christensen, T.; Thommesen, G. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1987. 31p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753037/JAW.

An examination of 50 Hz magnetic fields has been made in ten different Norwegian dwellings. The aim was to measure the general background level of the 50 Hz magnetic fields. The investigation followed a protocol also used in Swedish measurements, and direct comparisons are therefore possible. A portable, commercial coil instrument was used. In September 1986, and January 1987 the magnetic fields in living rooms, sleeping rooms, and kitchens were measured according to the standardized procedure. Current consumption and temperature at the time of the measurements were also recorded. A clear correlation was noted between the magnetic field values and the current consumption. The mean values of the magnetic fields in the living rooms, sleeping rooms and kitchens, were 12 nT, 11 nT and 160 nT, respectively. The living and sleep-

ing room values can be regarded as very low, and they are much lower than corresponding Swedish values. The kitchen values in the two countries seem, however, to be of the same order of magnitude. The report discusses the need for additional measurements in Norwegian houses.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 2955, 3063, 3176, 3177, 3457, 3458, 3459, 3460, 3461, 3462, 3511, 4513

3167 **(CONF-8709156—1-Vugraphs) Impact of new regulations on training programs.** Copenhaver, E.D. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000595/JAW.

From Industrial hygiene training workshop - DOE trade; Arlington, VA, USA (21 Sep 1987).

Safety and health training is creating a complex and overlapping training environment for all DOE contractors. Requirements stem from a variety of Federal and state regulations such as those from the Resource Conservation and Recovery Act (RCRA), the Superfund Amendments Reauthorization Act (SARA, whose training requirements are carried out by OSHA), Hazard Communication Act, and several substance-specific laws. The training requirements of these regulations and the trends toward overlapping the requirements of several laws are reviewed. Environment, safety and health training is offered by the technical staff members in the relevant disciplines and by our multi-discipline training group at ORNL. We are increasing our coordination of all such efforts to develop a more orderly overall program. We identified a team to work toward coordination of required technical training in environment, safety, and health by listing key opportunities for technical training modules and cross-qualification. The strategy for developing the training matrix is outlined. 13 figs.

3168 **(DP-MS—87-86) The role of performance criteria.** Cathey, S.S.; Emon, D.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant; USDOE, Washington, DC). Jul 1987. Contract AC09-76SR00001. 5p. (CONF-870713—60). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014840/JAW.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Performance criteria could play a primary role in future DOE NMC and A Orders. A performance-based system would use a combination of performance and compliance criteria to develop the DOE Order. The performance criteria concept, the benefits, the implementation, and the evaluation of a performance-based system will be discussed.

3169 (INIS-mf—11045, pp 693-716) **Considerations in the development of a site characterization field manual for near surface geologic disposal of LLNW.** Nowatzki, E.A.; McGray, J.G. (Arizona Univ., Tucson, USA. Dept. of Civil Engineering and Engineering Mechanics; Arizona Univ., Tucson, USA. Dept. of Nuclear Engineering). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The University of Arizona, under the sponsorship of the United States Department of Energy has recently (1985) developed a site characterization field manual for near surface geologic disposal of low-level nuclear waste (LLNW). The manual was developed to aid states and regions in formulating a program for the detailed characterization of a proposed near-surface disposal site. Included in the program are procedures for site characterization management, identification of pertinent technical parameters and methods for their determination, and the development of general procedures for conducting a site characterization study. The nine technical study areas identified as critical to LLNW disposal are discussed briefly in this paper. A representative parameter, fluid conductivity, is chosen from the area of groundwater hydrology to illustrate the format used in the manual to describe why that parameter is important and how it can be evaluated. An illustration is also given of the total characterization of a site with respect to geotechnical engineering parameters. Finally, a brief description is given of a general procedure for site characterization that can be used by planners, managers and staff personnel to implement the process of evaluating the suitability of a site for LLNW disposal.

3170 **(IS—4933) Atlas of atomic spectral lines of neptunium emitted by an inductively coupled plasma.** DeKalb, E.L.; Edelson, M.C. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000640/JAW.

Optical emission spectra from high-purity Np-237 were generated with a glovebox-enclosed inductively coupled plasma (ICP) source. Spectra covering the 230 to 700 nm wavelength range are presented along with general commentary on the methodology used in collecting the data.

3171 **(NUREG/CR—5003) Design of a material control and accounting system to protect against concealment of diversion by falsification and collusion.** Smith, B.W.; Byers, K.R.; Roberts, F.P.; Lewis, P.M. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards). Oct 1987. Contract AC06-76RL01830. 68p. (PNL—6308). NTIS, PC A04/MF A01 - GPO. Order Number DE88001347/JAW.

This report provides guidance for incorporating checks and balances in a nuclear material control and accounting (MC & A) system to control and detect falsification of data and reports that could conceal diversion of nuclear material. Data falsifications may be difficult to distinguish from mistakes in the data. The elements of control for data falsification are similar to existing security and accounting internal controls. Potential mechanisms for data falsification are identified and internal controls are discussed. Process monitoring systems supplement traditional MC & A by providing more timely detection of diversion and improved localization of losses, thereby providing additional controls against data falsification. However, there is a tradeoff in that personnel who have access to material are generating data for MC & A. Possibilities for collusion involving a person having both physical protection and MC & A responsibilities and another person having MC & A responsibilities are identified. Methods for protecting the system against a collusion threat are discussed.

3172 **(SAND—87-1980C) Experiences in teleoperation of land vehicles.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-8708156—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000429/JAW.

From Spatial displays and spatial instruments; Asilomar, CA, USA (31 Aug 1987).

Teleoperation of land vehicles allows the removal of the operator from the vehicle to a remote location. This can greatly increase operator safety and comfort in applications such as security patrol or military combat. The cost includes system complexity and reduced system performance. All feedback on vehicle performance and on environmental conditions must pass through sensors, a communications channel, and displays. In particular, this requires vision to be transmitted by closed circuit television (CCTV), with a consequent degradation of information content. Vehicular teleoperation, as a result, places severe demands on the operator. Experimentation studying the effects of vision-system characteristics on off-road, remote driving has been performed for conditions of fixed camera versus steering coupled camera and color versus black and white video display. Additionally, much experience has been gained through system demonstrations and hardware development trials. This paper discusses the preliminary experimental findings and the results of the accumulated operational experience.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 2982, 2984, 2996, 3007, 3008, 3009, 3010, 3034, 3036, 3037, 3038, 3039, 3041, 3042, 3044, 3092, 3115, 3167, 4325, 4513, 5365

3173 (CONF-860990—Pt.4, pp 57-67) **Moving toward a solution: a low-level radioactive waste management act for Massachusetts.** Smith, R.W. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

After more than three years of analysis and deliberation, the Special Legislative Commission on Low-Level Radioactive Waste has developed and filed with the Legislature the Massachusetts Low-Level Radioactive Waste Management Act. The act includes a multi-tiered process for the environmental screening of the entire state to site a low-level waste facility in Massachusetts, should it be determined that such a facility is necessary. Legislators, representatives of environmental and public interest organizations, state agencies, and the industrial, academic, medical, and nuclear power producing generators of low-level radioactive waste have worked with each other and the public to develop consensus legislation that ensures protection of public health while meeting Massachusetts' federally mandated responsibility. The process used to arrive at a consensus document and the critical policy initiatives developed are discussed.

3174 (CONF-860990—Pt.4, pp 68-76) **Progress in low-level waste compact arrangements: western regional status.** Tedford, C.F. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012445/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

This presentation reviews and highlights the following information related to low level waste compacts: Current compact group configuration and the approximate percentage of low level waste produced by each; Compares the relative volumes of low level waste generated by the top-20 producing states for 1985; Status of the Western Low Level Waste Compact in Arizona; Requirements of the Low Level Radioactive Waste Policy Amendments Act of 1985 that encourage the establishment of new low level waste disposal facilities in the 1990s; and Required support for regional and state low level waste plans and facilities.

3175 (CONF-860990—Pt.7, pp 109-116) **Radiation protection standards for the occupational workers and the public.** Minkin, S.C.; Dickson, R.L.; Halford, D.K. Feb 1987. NTIS, PC A06/MF A01. Order Number DE87012448/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Federal Regulations concerning radiation protection standards have been undergoing significant changes within the last decade. In addition to these changes, a proliferation in the number of Federal radiation standards has also occurred. A tabulation of these regulations aids in the understanding of which current standards apply to the nuclear industry with respect to environmental contamination and exposure to workers, and the public. Furthermore, most of the current regulations, proposed revisions, and proposed new rulings fall into several major categories. A tabulation of these categories illustrates common public, occupational, and environmental needs for which the DOE, NRC, and EPA have developed their specific radiation standards. Finally, risk based systems for radiation protection have been proposed by the DOE, NRC, and EPA, although these agencies are not entirely consistent in the application of this methodology. 2 tables.

3176 (INIS-XN—62) **Exchange of Notes constituting an Agreement concerning the application of the Agreement between Australia and the United States of America concerning peaceful uses of Nuclear Energy.** (International Atomic Energy Agency, Vienna (Austria)). 2 Aug 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700042/JAW.

Treaty Series 1985 No. 22.

This Agreement was concluded by an Exchange of notes constituting an Agreement between the Governments of Australia and the United States and concerns the application of different Articles in the Agreement of 5th July 1979 concerning peaceful uses of nuclear energy which entered into force on 16th January 1981. It details each Party's responsibilities regarding safeguards, physical protection and retransfers of nuclear material. It entered into force on the day of its signature and will remain in force for as long as the Agreement between both countries concerning peaceful uses of nuclear energy. (NEA).

3177 (INIS-XN—65) **Act of 17 April 1986 to implement Articles 7 and 8 of the Convention on Physical Protection of Nuclear Material, done in Vienna and New York on 3 March 1980.** (International Atomic Energy Agency, Vienna (Austria)). 14 Aug 1986. 3p. (In French and Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700045/JAW.

Published in Moniteur Belge.

The purpose of this Act is to implement in domestic legislation Articles 7 and 8 of the Convention on the Physical Protection of Nuclear Material, signed by Belgium on 13th June 1980. Article 7 of the Convention lays down that states Parties must provide for penalties for a number of serious offences with respect to nuclear material. Article 8 specifies the cases in which measures must be taken by States Parties to establish their jurisdiction over such offences. (NEA).

3178 (INIS-XN—71) **Order of 12 June 1986 amending Order of 26 March 1982 on protection and control of nuclear materials in course of carriage.** (International Atomic Energy Agency, Vienna (Austria)). 6 Jul 1986. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700051/JAW.

Published in Journal Officiel de la Republique francaise.

This order amends the Order of 26th March 1982 by including specific provisions on subcontracting the transport of spent fuel and nuclear materials in Category III. This category is the one requiring the less stringent controls as defined in the Decree of 12th May 1981 on protection and control of nuclear materials from the viewpoint of physical protection. (NEA).

3179 (INIS-XN—78) **Radioactive Substances (Substances of low activity) Exemption Order 1986 (No 1002).** (International Atomic Energy Agency, Vienna (Austria)). 12 Jun 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700055/JAW.

This Order came into operation on 14th July 1986 and applies to England, Wales and Scotland. It is concerned with exemptions and exclusions under the Radioactive Substances Act 1960 regarding certain substances of low radioactivity. The 1960 Act regulates the keeping and use of radioactive material and lays down general provisions for registration of users of radioactive material. (NEA).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

3180 **(GSI—87-13-Prepr.) Momentum-loss achromat - a new method for the isotopical separation of relativistic heavy ions.** Schmidt, K.H.; Geissel, H.; Muenzenberg, G.; Dufour, J.P.; Hanelt, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Mar 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750162/JAW.

The application of the slowing-down process of relativistic heavy ions in a layer of matter in ion-optical devices is theoretically investigated. The modifications of the phase space of the ion beam due to the dissipative forces and the straggling phenomena are discussed. Methods are developed to study the properties of the momentum-loss achromat, an isotope separator consisting of an achromatic magnetic system with an energy degrader located in the intermediate dispersive focal plane. This device separates projectile fragments with respect to A and Z up to uranium over a wide energy range with an efficiency in the order of 50% and with separation times of several hundred nanoseconds.

3181 (NEI-DK—39, pp 114) **Some aspects concerning the application of the universal Tc-99m generator.** Milenkovic, S.M.; Vucina, J.L.; Jacimovic, L.J.M. (The Boris Kidric Institute of Nuclear Sciences, Vinca, YU; The Institute for Radioisotopes, Belgrade, YU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

0702 Radiation Sources

REFER ALSO TO CITATION(S) 3778, 3874, 4095, 4096, 4117, 4284, 4286, 4287

3182 **(FEI—1811) Testing of local damages by surface activation method.** Konstantinov, I.O.; Leonov, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700333/JAW.

Papers on application of radioactivation methods for remote testing and investigation of the processes of surface damage due to wear and corrosion are analysed. Wide possibilities of the method of accelerated charged particle surface activation with a multilayer radionuclide tag and uniform distribution of radionuclide (Co/sup 56/, Fe/sup 59/) along the given local volume of the material (cast iron, steel) are shown. Methods of quantitative determination of such damage characteristics as weight less, a fraction of damaged surface and a mean depth of corrosion, as well as qualitative estimation of damage forms and occurrence of deep corrosion and caverns are considered. Techniques to develop any given (including uniform) distribution of the radionuclide according to the volum of a local tag are described. 12 refs.; 4 figs.

3183 **(IAEA-TECDOC—428) Electron beam processing of combustion flue gases. Final report of a consultants meeting held in Karlsruhe, 27-29 October 1986.** (International Atomic Energy Agency, Vienna (Austria)). Jul 1987. 289p. (CONF-8610346—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW.

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

This report contains the papers presented at the consultants' meeting on electron beam processing of combustion flue gases. The meeting provided an excellent opportunity for exchanging information and reviewing the current status of technology development. Characteristics of the electron beam processing recognized by the meeting are: capability of simultaneous removals of SO/sub 2/ and NO/sub x/, safe technology and simplicity of control, dry process without waste water to be treated, cost benefit of electron beam processing compared with conventional technology and the conversion of SO/sub 2/ and NO/sub x/ to a by-product that can be used as agricultural fertilizer. A separate abstract was prepared for each of the 22 papers in this technical report. Refs, figs and tabs.

3184 (IAEA-TECDOC—428, pp 13-20) **Research and development of electron beam treatment of combustion flue gases in Japan.** Machi, S.; Namba, H.; Suzuki, N. (Japan Atomic Energy Research Inst., Takasaki, Gunma. Takasaki Radiation Chemistry Research Establishment). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The research of electron beam treatment of combustion flue gases were first performed in Japan. The target gases are oil burning flue gas, steel sintering furnace flue gas and coal-fired flue gas. Addition of ammonia enhanced reduction of NO/sub x/ and SO/sub 2/ from these flue gases. The history of electron beam treatment of combustion flue gases in Japan is briefly reviewed. 12 refs, 13 figs, 2 tabs.

3185 (IAEA-TECDOC—428, pp 31-41) **Results of the initial experiments of SO/sub 2/ and NO/sub x/ removal by the E-beam method performed at the Swierk Nuclear Centre, Poland, in 1985-1986.** Brzozowski, W.S.; Licki, J.; Ratynski, W.; Wojtkowska, J.; Bigolas, J.; Bojemska, J. (Institute of Atomic Energy, Otwock-Swierk, Poland; Institute for Nuclear Studies, Otwock-Swierk, Poland; Experimental Establishment for Nuclear Equipment, Otwock-Swierk, Poland). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The purpose of this report is to present and discuss the initial results obtained during 1985/1986 at the Swierk Nuclear Centre using small experimental facility to study the efficacy of the E-beam method to remove the pollutants from flue gases (mainly from coal burning). Additional results are given concerning the influence of fly ash loading upon the efficiency of SO/sub 2/ and NO/sub x/ removal. 12 figs, 1 tab.

3186 (IAEA-TECDOC—428, pp 43-53) **Prospects of acidic pollutants removal from flue gases by combined electron beam - dry chemical process.** Sowinski, M.; Warych, J.; Chmielewski, A.G. (National Atomic Energy Agency, Warsaw, Poland; Warsaw Technical Univ., Poland. Inst. of Chemical Engineering; Institute of Nuclear Chemistry and Technology, Warsaw, Poland). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

In the paper the present techniques of SO/sub 2/ and NO/sub x/ removal from flue gases are discussed. Later, a combined electron beam-dry chemical process is proposed. The results of previous investigations of chemical process show high efficiency of desulfurization. The combined process may be used for simultaneous removal of SO/sub 2/ and NO/sub x/. The product obtained in the form of granules is simple to handle and store. 19 refs, 5 figs.

3187 (IAEA-TECDOC—428, pp 97-118) **Design notes on testing conducted during the period of June 1985-September 1986 on the process demonstration unit at Indianapolis, Indiana.** Frank, N.W.; Kawamura, K.; Miller, G.A. (Ebara International Corp., Greensburg, PA, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The testing on the demonstration unit installed at an electric utility power plant in Indianapolis, conducted during the period June 1985 to September 1986, is described. The influence of many process parameters on the operation and performance of the proc-

ess was evaluated. The effect of plant variables on byproducts is also discussed, and the quality of the byproducts evaluated. One of the main accomplishments of the testing done was the proof of the usability of commercial electron beam equipment in a power plant environment with high reliability and with high efficiency of removal of SO/sub 2/ and NO/sub x/ from flue gases generated by burning from low to medium sulfur coals. 21 figs.

3188 (IAEA-TECDOC—428, pp 119-133) **Removal of NO/sub x/ and SO/sub 2/ by the electron beam process.** Fuchs, P.; Roth, B.; Schwing, U. (Badenwerk A.G., Karlsruhe, Germany, F.R.). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

A demonstration unit with two low energy (300kV), high power (90kW) accelerators was installed at the by-pass loop of Badenwerk AG power plant in Karlsruhe. The main elements of the process for removal of toxic gases and details of the installation are given. Some results obtained during the initial testing period are also included. The most important finding is the unambiguous proof of the suitability of the electron beam process for flue gas purification. The objectives of further tests are discussed. 13 figs, 2 tabs.

3189 (IAEA-TECDOC—428, pp 153-165) **High power self-shielded electron processors and their application to stack gas treatment.** Hiley, J.; Frutiger, W.A.; Nablo, S.V. (Heriott-Watt Univ., Edinburgh, UK. Electrical and Electronic Engineering Dept.; Energy Sciences Inc., Woburn, MA, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The increasing industrial demands for large width (approximately 2 m), high dose rate (1 megarad at 1500 meters/minute) electron beam machinery has led to a relatively rapid improvement in this field over the past several years. Self-shielded machinery capable of up to 1000 mA of current at 300 kilovolts is now in commercial use, and the essential features of these designs are presented. A variety of product handling geometries for use with these accelerators have been developed, for processes involving flexible web, rigid sheet, and three dimensional objects in both the polymerization and sterilization applications. One of the major power intensive processes to which these machines are currently applied is that of the reduction of pollutants (NO/sub x/, SO/sub 2/, etc.) in the flue gas from fuel combustion - particularly those fossil fuels used in power production. The preferred technique utilizes the treatment of the ammoniated gas at modest dose levels (0.5 - 2.0 megarads) to enhance the formation of ammonium salts which are then removed from the gas stream by conventional filtration. Some results from a 180 kW x 300 kV pilot installation in Karlsruhe, West Germany, are presented. 9 refs, 8 figs.

3190 (IAEA-TECDOC—428, pp 167-178) **Development of large, high power electron beam sources for use in the processing of combustion flue gases.** Klein, A.F. (RPC Industries, Hayward, CA, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The simultaneous removal of SOx and NOx from combustion flue gases by means of electron beam processing has been successfully demonstrated. However, the use of this technology in commercial power plants depends critically upon the availability of large, high power (i.e., up to 1,000 kW), low energy (i.e., 300 kV) electron beam processors that are reliable, efficient and cost effective. Utilizing its broad beam electron source, RPC Industries has developed dual head modules up to 2500 mm wide with the required beam power for the efficient processing of combustion flue gases. Units of this size and capacity are already in commercial operation and additional modules are under construction. The operating principles and performance features of these broad beam processors are described, with special emphasis on those aspects of the system that relate directly to stack gas applications. 8 figs.

3191 (IAEA-TECDOC—428, pp 179-184) **Electron beam specifications for flue gas treatment.** Lopez, E.J. (Radiation Dynamics, Inc., Melville, Long Island, NY, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

Electron Beam treatment of flue gas is in the early stages of market development. The process is able to treat a wide range of gas volumes and types. This paper presents suggested electron beam specifications. Certain specifications, such as maximum electrical efficiency, are uniformly required. However, other specifications, including accelerator voltage and secondary window configurations, have different requirements depending upon the application and customer preference. The suggested specifications will be modified as more systems are installed in the field. 1 fig.

3192 (IAEA-TECDOC—428, pp 201-209) **Some considerations on electron beam processing of combustion flue gases.** Sakamoto, I.; Mizusawa, K.; Kashiwagi, M. (Nissin - High Voltage Co. Ltd., Kyoto, Japan). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The main requirements and basic radiation engineering problems for electron beam processing of combustion flue gases are discussed. Special attention is given to matters affecting efficiency, design of radiation chamber and shielding requirements. The various parameters are influenced by the energy of the electron beam. 7 figs, 2 tabs.

3193 (IAEA-TECDOC—428, pp 219-225) **Energy efficiency and dose distribution of 300 kV - 800 kV electron beam system for the treatment of flue gas.** Offermann, B.P. (AEG, Wedel, Germany, F.R.). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The removal of SO/sub 2/ and NO/sub x/ from flue gas by using high energetic electron beams is an interesting new process. The removal cost depends strongly on the overall efficiency of the electron beam system. The overall efficiency is given by the degree of efficiency for the production of high energetic electrons, energy losses in the 'windows' that separate the vacuum chamber of the electron accelerator from the flue gas (window efficiency) and the dose distribution in the flue gas. Systems using conventional dc-power supplies (oil insulated) have advantages over high-frequency gas insulated power supplies. The 'window efficiency' and dose distribution are better for high energy systems (e.g. 800 kV) than for low energy systems (up to 300 keV), while the investment costs are higher for high energy systems. 2 figs, 1 tab.

3194 (IAEA-TECDOC—428, pp 239-251) **Review of conventional methods for SO/sub 2/ and NO/sub x/ removal in Europe.** Ellison, W. (Ellison Consultants, Monrovia, MD, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

As a result of the landmark, 1983 West German legislation (GFAVO) mandating SO2 emission reductions in existing fossil-fired boilers there are, as of 1986, more than 100 large FGD systems with greater than 40,000 MW(e) aggregate capacity in operation or under construction in West Germany alone. More than 93% of these are of the form of usable-gypsum-producing wet lime/limestone scrubbing. 1983 West German legislation requires the retrofit addition by 1993 of approximately 400 more smaller FGD installations aggregating approximately 25,000 MW(e). Land availability in mainland European countries is such that it is generally necessary to apply usable-byproduct-forming FGD systems to avoid need for throwaway disposal of FGD solid waste. As a result of very stringent new nitrogen oxides (NOx) limits established in West Germany in 1984 for existing boilers there are, as of 1986, approximately 50 high-efficiency commercial NOx removal systems

aggregating more than 10,000 MW(e) capacity in operation, announced or under construction. Approximately 30,000 MW(e) of additional NOx removal capacity will be required to be retrofitted by deadlines during the period 1988 to 1990. Systems applied to date primarily use selective catalytic reduction (SCR) technology, which employs ammonia reagent to chemically convert nitrogen oxides to normal atmospheric nitrogen. 14 refs, 1 fig, 2 tabs.

3195 (IAEA-TECDOC—428, pp 265-272) **Present status and potential development of electron beam processing in China.** Qian, Y.L. (Academia Sinica, Shanghai, SH, China. Shanghai Inst. of Nuclear Research). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

Along with the development of industry the air pollution and acid rain problems have caused concern in China. To prevent the development of air pollution problem several processing methods for removal of SO/sub 2/ from flue gases have been tested. Since the inherent advantages of electron beam processing, especially the produced fertilizer by this method is badly needed in China, this technology is one of the most prospective in the future. The development of electron beam processing of flue gases for power industry is described. The possibility of manufacturing of electron beam sources are also briefly introduced. 2 refs, 1 tab.

3196 (IAEA-TECDOC—428, pp 273-285) **Treatment of flue gases - need and potential for advanced technology in India.** Iya, V.K.; Krishnamurthy, K.; Majali, A.B. (Bhabha Atomic Research Centre, Bombay, India. Isotope Div.). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The application of radiation technology for treatment of stack gases is of great significance to India, where industrial growth is making rapid strides and the thrust areas include power generation, fertilizer production and petrochemical industry. This paper briefly summarizes the status of thermal power generation, fertilizer production, petrochemical industry and steel in India. The levels of industrial pollutants in the metropolitan areas of Bombay, Calcutta and New Delhi are indicated, and data regarding contribution to pollution from the various industries are presented. The awareness amongst various sections of Indian people and legislative aspects relating to air pollution at the state and national level as well as steps taken by industry are discussed. In view of the greater emphasis on pollution emanating from the large thermal power plants and other industries located in the metropolitan areas of New Delhi and Bombay, it is envisaged that demonstration of this technology will be attempted in the very near future, in India. The installation of a 2 MEV multipurpose electron accelerator will provide the necessary stimulus for further work in utilizing this new technology. 5 tabs.

3197 (INIS-mf—10996, pp 49-50) **Preparation of thin / sup 226/Ra sources by the electro-spray technique.** Hernegger, F.; Chalupka, A. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

3198 (INIS-mf—11037, pp 35) **Materials science and shape memory - a memory of the future.** Fitzgerald, F.M. (Memtec Ltd., Seven Hills, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3199 (INIS-mf—11037, pp 61) **Radiation as a tool for water purification: a comparison between high energy ionizing and low energy ultraviolet.** Matthews, R.W. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Energy Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3200 **X-ray safety at the Los Alamos National Laboratory.** Gutierrez, J.A. (Los Alamos National Lab., P.O. Box 1663, M.S. K487, Los Alamos, NM 87545). pp 326-329 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

An organized and structured safety program for x-ray generating devices was initiated in October, 1979. An X-ray Device Control Office was established to manage the program that currently oversees the activities of 201 x-ray generating devices and to provide SOP reviews, perform shielding calculations, and provide training for both the operators and health physics x-ray device surveyors. The new program also establishes controls for procurement of new equipment, requires the writing of Standard Operating Procedures, requires training for operators and provides routine and non-routine safety inspections of x-ray generating devices. Prior to this program going into effect, the Laboratory had recorded nine documented x-ray related exposure accidents. Since then, there have been none. Program elements and experiences of interest to other x-ray device users are discussed.

3201 **Production and shielding of X rays from electron beam vapor sources.** Singh, M.S. (Lawrence Livermore National Lab., P.O. Box 5505, Livermore, CA 94550). pp 277-286 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Electron beam vapor sources are now widely used in material processing sciences and coating technologies, such as the semiconductor industry for producing aluminum films on Si wafers; the metallurgical industry for melting, evaporating, and refining metals; and at Lawrence Livermore National Laboratory (LLNL) for vaporizing metals for laser isotope separation applications. Power for these sources range from the kW regime in the semiconductor industry to the multi-MW regime in laser separation technology. Operations of these sources can generate copious amounts of x rays by the direct and indirect interactions of the energetic electrons with the target materials. In this paper, the author presents the results of his calculations regarding the x-ray emission intensity, angular intensity and energy spectrum distribution, and shielding characteristics for vapor sources with acceleration voltages from 10 kV to 60 kV.

08 HYDROGEN

0801 Production

3202 **(DOE/ER/10671—5) Intramolecular energy transfer reactions as a method for metal complex assisted production of hydrogen: Fifth report for the period 1 December 1983-1 December 1986.** Petersen, J.D. (Clemson Univ., SC (USA). Dept. of Chemistry). 1987. Contract AS09-80ER10671. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001621/JAW.

Research is reported on ruthenium(II) antenna fragments, ruthenium(II) neutral complexes, iron(II) antenna systems, and biimidazolate complexes. (DLC)

3203 **(DOE/PC/90526—2) Partial oxidation of light alkanes in transition-metal ion containing zeolite: [Quarterly report, December 15, 1986-March 14, 1987].** Klier, K.; Lin, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90526. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001301/JAW.

The optical spectra of dehydrated Co(II)A zeolite have been measured at temperatures between 77 and 300°K. The band intensity at 25,000 cm^{-1} increased approximately as the reciprocal square root of absolute temperature above 200°K. However, the splitting potentially due to Jahn-Teller effect remained almost unchanged. A tentative theory of the dynamic Jahn-Teller splitting for the $E' \rightarrow E''$ transition has been developed to interpret the observed doublet spectrum and its temperature dependence. 7 refs., 3 figs.

3204 **(PB—87-232229/XAB) Vectorial electron transfer on designed surfaces. Annual report, February 1986-January 1987.** Bard, A.J.; Campion, A.; Fox, M.A.; Mallouk, T.E.; Webber, S.E. (Texas Univ., Austin (USA). Dept. of Chemistry). 1987. 114p. NTIS, PC A06/MF A01.

See also annual report for January 1983-January 1984, PB—84-198530.

Bipolar CdSe/CoS semiconductor photoelectrode panels, capable of vectorial electron transfer, were used in series arrays to photodecompose water to yield hydrogen and oxygen in stoichiometric ratio with a maximum solar efficiency of about 1%. An analytical model was developed for these arrays which addresses the question of water splitting and electrical power-generation efficiencies as functions of the number of panels, the overpotentials of the gas-generating electrodes, incident light intensity, and the concentrations of the redox couples. Hydrogen production using a self-assembling zeolite system was discovered. Sensitized anatase TiO_2 electrodes were used in photoelectrochemical cells employing a variety of solution redox couples (iodide, ferrocyanide, hydroquinone derivatives). The photoassisted production of hydrogen from methanol-water solutions containing mixtures of small particles of CdS/SiO_2 and a wide bandgap semiconductor (TiO_2, ZnO, SnO_2 or WO_3), supported on silica and platinized was studied. The phenomenon of interparticle charge separation for CdS/SiO_2 was found to be operative for CdS/SiO_2 with WS_2/SiO_2.

3205 **Photoassisted catalytic dissociation of H_2O to produce hydrogen on partially reduced α-Fe_2O_3.** Khader, M.M.; Vurens, G.H.; Kim, I.K.; Salmeron, M.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 12, 3581-3585(10 Jun 1987). Contract AC03-76SF00098.

The photodissociation of H_2O on partially reduced Fe_2O_3 powders and pellets is shown to be a catalytic process if the semiconductor is illuminated by visible light of energy greater than 2.2 eV. Activation of the Fe_2O_3 catalysts involved reduction in a mixture of H_2 and H_2O followed by oxidation. Up to 380 μmol of H_2 were produced with 190 μmol of Fe_2O_3 powder. The rate was 40 $\mu mol\ h^{-1}\ g^{-1}$ for the first 200 h and started to decay thereafter. O_2 was also produced as shown by using $H_2{}^{18}$ in amounts of up to 40 +/- 15% of the amount of H_2 detected in the same experiment. In photoelectrochemical experiments with use of a three compartment cell the active pellets produced photocurrents of approximately 4 $^{+}A\ cm^{-2}\ mW^{-1}$ at + 0.5 V bias (SCE, pH 13). Simultaneously, H_2 was produced at a rate of 0.06 $\mu mol\ h^{-1}\ mW^{-1}$. A lower limit to the conversion efficiency of approximately 10^{-3} H_2 molecules per photon is obtained.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 4016

3206 **(DOE/ER/10945—T6) Characterization of the organization of the genome of methanogens and development of genetic exchange systems for Methanococcus vannielii: Final report for the period July 1, 1981-June 30, 1987.** Reeve, J.N.; Frea, J.I. (Ohio State Univ., Columbus (USA). Dept. of Microbiology). Oct 1987. Contract AC02-81ER10945. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001547/JAW.

The goals of this contract were to characterize gene organization and expression in methane microorganisms and to develop gene transfer systems for these unusual anaerobes. Antibiotic resistant mutants were isolated, potential shuttle vectors constructed and a number of methanogen genes cloned which when functionally expressed in Escherichia coli complemented auxotrophic mutations of eubacterial species. DNA sequencing of cloned genes was used to establish evolutionary relationships between methanogens and showed the conservation of DNA sequences in archaebacterial, eubacterial and eucaryotic species. Sequencing demonstrated that methanogens use the standard genetic code, have polypeptide-encoding genes organized into operons, initiate translation using ribosome binding sites (RBS) and terminate transcription by forming double-stranded loops in RNA molecules. All these are molecular biological features typical of eubacteria. In contrast, the presence of conserved sequences and protection of DNA from nuclease digestion by bound methanogen-derived RNA polymerases indicated that methanogen promoters do not resemble eubacterial promoters. The initial cloning and sequencing of amino-acid and purine biosynthetic genes from methanogens provided the necessary background information to undertake cloning and analysis of genes which encode enzymes directly involved in methanogenesis. The most abundant enzyme in all methanogens is methyl coenzyme-M reductase which catalyzes the terminal reaction in methanogenesis. The genes which encode the subunits of component C of this enzyme in Methanococcus vannielii have been cloned and sequenced. Their organization and structure indicates that, in vivo, component C may contain previously unrecognized subunits and its synthesis may be regulated at the level of translation. Genes encoding subunits of the major non-F_{430} reducing hydrogenase of Methanobacterium thermoautotrophicum have also been cloned and sequenced. 16 refs., 1 fig.

3207 **(DOE/PC/80016—T5) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 7 for the period 1 April to 30 June 1987.** Tong, G.T.; Wilson, R.B.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 9 Sep 1987. Contract AC22-85PC80016. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000883/JAW.

Three monomeric supported ruthenium catalysts were evaluated for Fischer-Tropsch performance with 1:1 H_2:CO synthesis gas at 1 atm. This effort completes the FTS evaluation of a series of nine supported multiatomic and atomic ruthenium catalysts prepared via organometallic reactions of tetra- and hexaruthenium hydridocarbonyls and allyl monoruthenium carbonyl complexes with acid sites on three support materials, alumina, sodium Y zeolite, and molecular sieve. The ruthenium catalyst supported on sodium Y zeolite had superior FTS performance relative to a conventionally prepared alumina-supported ruthenium catalyst. Its chain growth factor was higher, methane selectivity lower, and olefin-to-paraffin ratio for light hydrocarbons higher. The results for the molecular sieve catalyst under the same reaction conditions were inferior with low chain growth parameter and high methane selectivity. The C/ sub 2+/ hydrocarbon synthesis rates of all the ruthenium catalysts were comparable. The effect of high-level sulfur chemisorption on the FTS performance of alumina-supported cobalt was also examined. The untreated cobalt catalyst had higher activity and higher

methane selectivity relative to the standard fused iron catalyst. 4 figs., 2 tabs.

3208 **(EMR—8704) An investigation of the fast pyrolysis of cellulose and wood.** Bergougnou, M.A.; Graham, R.G.; Freel, B.A.; Vogiatzis, L. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Apr 1987. 238p. (MICROLOG—87-03754). Renewable Energy Branch, Energy Mines and Resources Canada, 460 O'Connor Street, Ottawa, Ont., Canada K1A 0E4;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A fast pyrolysis program (Ultrapyrolysis) at the University of Western Ontario, initiated under Environment Canada, was continued and expanded under the Bioenergy Program of the National Research Council of Canada. The equipment was modified and refined to make it suitable for kinetic studies. The gas-phase kinetics for the production of total gas, carbon oxides, hydrogen, olefins, and other hydrocarbons were characterized during the fast pyrolysis of cellulose and wood (i.e. poplar and red maple) feedstocks at temperatures between 650 and 900/sup 0/C. The production of these major gaseous components was found to fit a first order kinetic model quite well. General insights associated with primary pyrolysis mechanisms and refinements of earlier published mechanisms were made possible by primary liquid analysis and extrapolations over time. Product distributions were found to be compatible with flash pyrolysis results from the Waterloo University fluidized bed unit, over a wide range of temperatures. The relative importance of secondary gas-phase reactions (i.e. cracking, reforming, water-gas shift, etc.) was evaluated, and the integrity of the reactor as a valid kinetic tool was verified by a comparison of experimental ethane cracking kinetics with published kinetics.

3209 **(GAO/RCED—86-136FS) Alternative fuels: Potential of methanol as a boiler or turbine fuel.** (General Accounting Office, Washington, DC (USA)). 1986. 20p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Methanol is not economically attractive as a boiler or turbine fuel in the near term because of its high cost and a plentiful supply of coal, oil, and natural gas. Although tests have shown that methanol is technically viable as a primary fuel in boilers, it is generally not used because of its relatively higher cost compared to other boiler fuels. Tests have also shown that methanol has a somewhat lower thermal efficiency than these fuels in boiler uses.

3210 **(NSTU/CES—8411) Determination of the combustion and heat transfer characteristics of CBDC coal-water mixture in comparison to heavy fuel oil.** Casey, H.; Pegg, M.; Todd, A. (Nova Scotia Technical Univ., Halifax (Canada). Centre for Energy Studies). Nov 1984. 276p. (MICROLOG—87-04001). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report describes the experimental procedures and results of a series of tests to determine the combustion and heat transfer characteristics of heavy fuel oil in comparison to coal water fuel. All the tests were performed in the Centre for Energy Studies combustion test facility located at the Technical University of Nova Scotia. A thermal input of 1.8 MW was used for all tests and a furnace load of 0.81+/-0.1 MW (which corresponds to 44-46% of the thermal input) was maintained throughout the test program. A potential second generation burner nozzle was used. The variable geometry nozzle was designed to fire both heavy fuel oil and coal water fuel, and employed ceramics developed to overcome nozzle erosion. The nozzle performed satisfactorily for both fuels and no wear was observed. Various in-flame measurements were made on fully optimised flames at two excess oxygen levels. Tests were also made on air and steam atomised flames. In addition, analytical tests were made on samples of in-flame particulates and deposited ash. The heat flux characteristics of the two fuels were examined by measuring the radiant and total heat flux for each test flame. Although the tests were of a short duration no erosion was observed on the atomiser components. Eight appendices are included with this report detailing the facilities available, test methods and measurements, results of calculations, and the operator's log sheets and data from the five tests. 23 fig., 54 tabs.

3211 **(PNL-SA—14552) A process study of the biothermal conversion of water hyacinths to methane.** Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr.; Chynoweth, D.P. (Pacific Northwest Lab., Richland, WA (USA); Florida Univ., Gainesville (USA). Inst. of Food and Agricultural Sciences). May 1987. Contract AC06-76RL01830. 29p. (CONF-870523—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000554/JAW.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

A hybrid process employing both biological and thermochemical conversion of biomass to methane was studied. A unique high-moisture catalytic gasifier concept was used to gasify the effluent from an anaerobic digester. An ASPEN-PLUS/sup tm/ simulation of the process concept was based upon experimental data obtained from individual process components. An overall process efficiency of 78.1 to 94.1% was determined, depending upon the process configuration. Extensive use of heat and power recovery is required to achieve the high efficiencies reported for the process. 6 refs., 3 figs., 9 tabs.

3212 **(PNL-SA—14911) Hydrocarbon transjortation fuels from biomass: An overview of thermal conversion research.** Stevens, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 6p. (CONF-870804—43). NTIS, PC A02. Order Number DE88000548/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Biomass is an important energy resource at present and offers excellent potential for increased energy impact in the future. This potential energy impact expected to be met in part by liquid transportation fuels derived from biomass. Liquid fuels are more energy dense than biomass itself and more closely match existing end-use patterns. In this paper, research sponsored by the US Department of Energy's Biofuel and Municipal Waste Technology Division on the production of liquid hydrocarbon fuels from biomass is discussed. These fuels are generated by first converting the biomass resource to biocrude oils and then upgrading those to hydrocarbon products. An overview of the ongoing research program is presented. 7 refs., 7 figs., 3 tabs.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 3830, 3931

3213 **Zymomonas mobilis mutants with an increased rate of alcohol production.** Osman, Y.A.; Ingram, L.O. (Univ. of Florida, Gainesville). *Applied and Environmental Microbiology;* **53**: No. 7, 1425-1432(Jul 1987).

Two new derivatives of Zymomonas mobilis CP4 were isolated from enrichment cultures after 18 months of serial transfer. These new strains were selected for the ability to grow and produce ethanol rapidly on transfer into fresh broth containing ethanol and allyl alcohol. Ethanol production by these strains was examined in batch fermentations under three sets of conditions. Both new derivatives were found to be superior to the parent strain CP4 with respect to the speed and completeness of glucose conversion to ethanol. The best of these, strain YO2, produced 9.5% ethanol (by weight; 11.9% by volume) after 17.4 h compared with 31.8 h for the parent strain CP4. The addition of 1 mM magnesium sulfate improved ethanol production in all three strains. Two factors contributed to the decrease in fermentation time required by the mutants: more rapid growth with minimal lag on subculturing and the retention of higher rates of ethanol production as fermentation proceeded. Alcohol dehydrogenase isozymes were altered in both new strains and no longer catalyzed the oxidation of allyl alcohol into the toxic product acrolein. This loss of allyl alcohol-oxidizing capacity is proposed as a primary factor contributing to increased allyl alcohol resistance, although it is likely that other mutations affecting glycolysis also contribute to the improvement in ethanol production.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 2815, 3246

3214 (ETSU-L—20) Waste derived fuels - an update: combustion and landfill gas. Landy, M.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Mar 1987. llp. (CONF-8706221—). British Library Document Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

From 89. annual wastes management conference; Torbay, UK (16 Jun 1987).

This paper aims to provide Waste Disposal Authorities and Private Waste Contractors with an up-to-date summary of the situation in various waste to energy technologies. Some technologies, such as mass-burn incineration, are fully commercial now, but their rate of uptake is limited by economic considerations. Other technologies like pelletised RDF can offer substantial savings on waste disposal costs, but have yet to prove themselves fully in a commercial environment. Landfill gas exploitation is proving to be the most attractive option as it offers good economic returns for relatively small investments, and can simultaneously solve the problems caused by gas migration into the environment. Although it is unlikely to substantially reduce disposal costs, the scope for landfill gas utilisation is enormous and a high level of activity can be expected in this area for some time. The waste preparation and combustion technologies are typically at an earlier stage of development, but show great promise for cutting disposal costs with minimal environmental impact.

3215 (NS/F—8705) Woodchips and biomass. Report of the Select Committee on Forestry. (Nova Scotia Select Committee on Forestry (Canada)). May 1987. 55p. (MICROLOG—87-04079). Nova Scotia Dept. of Lands and Forests, Toronto-Dominion Bank Bldg., 1791 Barrington St., PO Box 698, Halifax, N.S., Canada B3J 2T9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An inquiry into wood waste, wood residue, and biomass as it relates to a source of energy in Nova Scotia was conducted under the direction of the Select Committee on Forestry. The use of wood for energy will enhance Nova Scotia's energy security and the province will also benefit from improved forest management practice. An assessment is made of the current situation and included is a description of the provincial and federal government involvement in wood energy developments. Technologies of wood fuel use are reviewed, including heating, cogeneration, district heating, heat storage, and the harvesting and transporting of chipped wood fuel. Nova Scotia's wood fuel supply and demand and costs have been assessed, and the economic considerations are outlined. The Committee's recommendations included the establishment of a program for feasibility studies of wood fuel substitution, the conversion of government owned or supported facilities where wood fuel substitution is cost effective, and the recognition of the economic advantages of forest management practices. 2 tabs.

3216 (WSL-LR—599-MR) Combustion of refuse derived fuel on a triple chain grate stoker shell boiler. Khatri, N.U.; Burnley, S.J. (Warren Spring Lab., Stevenage (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 18p. (ETSU-B—1136(c)). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Refuse derived fuel (RDF) firing trials were carried out on a 7.3 MW triple chain grate stoker boiler. A thermal efficiency of 63% at 51% of the maximum continuous rating (MCR) was achieved, compared with an efficiency of 82% and 97% of MCR for coal firing. Particulate emissions averaged 4.46 kg h^{-1} for RDF and 6.73 kg h^{-1} for coal and are below the 9.1 kg h^{-1} recommended limit for an MCR of 7.3 MW. However, plume obtrusiveness was unacceptable for RDF as over 70% (13% for coal) of the emitted particles were less than 1.5 μm. The fuel handling system was unsuitable for RDF as numerous stoppages were associated with pellets jamming the drag link conveyor system. The bucket elevator and storage hoppers were suitable, and no problems were encountered with the ash handling system. If this boiler is to be converted to RDF combustion, it is recommended that the fuel handling system is modified or replaced, that the combustion air control and distribution is improved and that the installation of a secondary air supply to reduce the plume visibility is considered.

13 HYDRO ENERGY

1303 Plant Design And Operation

3217 (GAO/RCED—86-208FS) Federal electric power: Repairs made on turbines at two Arkansas River dams. (General Accounting Office, Washington, DC (USA)). 1986. 6p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Since 1982, the Corps of Engineers has repaired eight electricity-generated turbines at the Ozark and Webbers Falls dams located on the Arkansas River. All eight turbines were in operation as of May 23, 1986, and no further problems have occurred. Although the Corps considered litigation against the manufacturer of the turbines on the basis of latent design defects, no action was initiated because of a Corps' consultant concurred with the turbine manufacturer's contention that the failures were due to defects that were beyond the state-of-the-art turbine design in the late 1960s.

1304 Regulations And Licensing

3218 (APUB—E87025) Decision E87025 dated April 2, 1987 re: Alberta Power Limited in the matter of an application by Alberta Power Limited for an increase in rates. (Alberta Public Utilities Board, Edmonton (Canada)). 2 Apr 1987. 273p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Public Utilities Board, Alberta, issued Order E86071 October 1, 1986 approving interim rates for Alberta Power Limited (APL) effective on billings on and after October 1, 1986, with reasons outlined in Interim Decision E86071 and amended by Order E86096. This decision determines APL's Rate Base, Fair Return on Rate Base, and Total Electric Utility Revenue Requirements for the approved test years 1986 and 1987. Reasons for the Board's decision are provided and discussed. Detailed financial data are included.

3219 (APUB—E87046) Order E87046 dated May 29, 1987 re: Alberta Power Limited in the matter of an application by Alberta Power Limited for an increase in rates. (Alberta Public Utilities Board, Edmonton (Canada)). 29 May 1987. 48p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

The Public Utilities Board, Alberta, issued Order E86071 approving interim rates for Alberta Power Limited (APL) effective on billings on and after October 1, 1986. Decisions E86072 and E87025 amended that Order. This Order sets out rates to be imposed by APL effective June 1, 1987 and replaces those earlier set in Order E86071 and Decisions E86072 and E87025. Financial data are included.

3220 (NEB-SS—22-1/1987-9E) Reasons for decision in the matter of the application under the National Energy Board Act of the Manitoba Hydro-Electric Board. (National Energy Board, Ottawa, Ontario (Canada)). Aug 1987. 25p. National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Applicant, Manitoba Hydro, is a Crown Corporation established in 1949 by the provincial legislature. It has broad powers to provide electric power throughout the province and operates under the Manitoba Hydro Act. The Manitoba Energy Authority is a Crown Corporation established in 1980 by the Manitoba Legislature under the Manitoba Energy Authority Act. MEA is vested with the statutory duty to negotiate or direct negotiations for the

purchase and sale of electric energy. MH requires the approval of MEA before it can export from or import power into Manitoba. MH distributes electricity to consumers throughout the province with the exception of a portion of Winnipeg. MH and Winnipeg Hydro operate as an integrated electrical generation and transmission system. MH is a liason participant in the Mid-Continent Area Power Pool while Northern States Power Co. is a full member. MH requested a firm export licence to sell to NSP a maximum of 200 MW of firm power with a maximum of 833 GW.h of energy in each of the six-month periods from May 1 to October. 31 of the years 1993-1996. The export would take place over existing international power lines. 4 tabs.

3221 **(NEB-SS—22-1/1987-9F) Motives for decision relative to a present demand by virtue of the law on the National Office of Energy by the Administration of Hydroelectricity of Manitoba.** (Office Nationale de l'Energie, Ottawa, Ontario (Canada)). Aug 1987. 25p. (In French). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

The Applicant, Manitoba Hydro, is a Crown Corporation established in 1949 by the provincial legislature. It has broad powers to provide electric power throughout the province and operates under the Manitoba Hydro Act. The Manitoba Energy Authority is a Crown Corporation established in 1980 by the Manitoba Legislature under the Manitoba Energy Authority Act. MEA is vested with the statutory duty to negotiate or direct negotiations for the purchase and sale of electric energy. MH requires the approval of MEA before it can export from or import power into Manitoba. MH distributes electricity to consumers throughout the province with the exception of Winnipeg. MH and Winnipeg Hydro operate as an integrated electrical generation and transmission system. MH is a liason participant in the Mid-Continent Area Power Pool while Northern States Power Company is a full member. MH requested a firm export licence to sell to NSP a maximum of 200 MW of firm power with a maximum of 833 GW.h of energy in each of the six-month periods from May 1 to October 31 of the years 1993-1996. The export would take place over existing international power lines. 4 tabs.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 4425

3222 **(AD-A—182999/3/XAB) Environmental and water-quality operational studies: hydrodynamics and modeling of reregulation pools. Final report, October 1982-September 1984.** Berger, R.C. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). May 1987. 92p. (WES-TR-E—87-6). NTIS, PC A05/MF A01.

A reregulation dam is used to reduce drastic fluctuations from main reservoir releases, usually as a consequence of hydropower operations. In a pumped-storage system, it also provides storage for subsequent pumpback to the upstream reservoir. This report describes the expected impact of the addition of a reregulation pool system. A cost-effective method for simulating the hydrodynamics and transport in a reregulation pool is presented. The method was coupled with a vertical one-dimensional reservoir model to simulate the hydrodynamics and transport of the reservoir-reregulation pool system. The modeling procedure for simulating the hydrodynamics and transport of the reregulation pool was selected from three candidate methods. The three methods in progressive order of complexity are: (1) the sump method, (2) the level pool routing method, and (3) the finite-difference simulation of the Saint-Venant equations. The methods were incorporated within the WESTEX model, and the predicted temperature profiles in the main reservoir and the release temperatures from the regulation pool are compared to results from a reservoir study previously conducted at the Waterways Experiment Station.

3223 (DOE/BP—868, pp 1-19) **Collawash River habitat improvement project Hot Springs Fork Collawash River.** Cain, T.; Hohler, D. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

The Hot Springs Fork of the Collawash River is a major sub-drainage in the Clackamas River drainage. Emphasis species for natural production are spring chinook and coho salmon, and winter steelhead. Increased natural production appears limited by a lack of quality rearing habitat. Habitat complexity, over approximately 70% of the area accessible to anadromous fish, has been reduced over the last 40 years by numerous factors. Additionally, natural passage barriers limit anadromous fish access to over 7 miles of high quality habitat. In the second year of a multi-year effort to improve fish habitat in the Hot Springs Fork drainage, a 0.9 mile reach of the Hot Springs Fork mainstem was treated. The objectives of this years work were: 1) to increase channel complexity, and 2) improve low flow and over winter rearing conditions. Seventy-five trees were felled and more than 165 boulders, 1-4 cubic yards each, were hauled in and used to construct approximately 137 instream structures. A perennial side channel was also created by excavating out a high flow channel. The side channel will provide additional spawning habitat and slow water refuge during periods of high flows in the mainstem. The side channel may also provide low flow rearing habitat for coho salmon, resident and steelhead trout. Initial attempts to improve passage over a waterfall were made using non-explosive techniques. These attempts were unsuccessful due to nature of the rock and additional work is needed to improve passage. Prior to project implementation pre-project monitoring, consisting of physical and biological data collection, was completed in the project area.

3224 (DOE/BP—868, pp 20-47) **Collawash River Falls passage improvement project.** Medel, R. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

The Collawash River is the largest tributary of the upper Clackamas River, providing approximately one third of the low flow volume. Fish habitat is generally rated good to excellent throughout the Collawash. A 12-15 foot falls at RM 7.4 is a partial to complete barrier (depending on discharge) to spring chinook, coho salmon, and steelhead. The falls blocks access to an estimated 10 stream miles of upstream anadromous fish habitat. 1986 was the third year of planned multi-year efforts to improve anadromous fish passage at Collawash River falls. Accomplishments for 1986 included the processing of environmental documentation stating selection of the preferred action alternative (pool development), preliminary designs for jump pool construction by a fisheries engineer, intensive project site surveys and topographic map development, and preparation of the contract for final design and construction. All work was completed within the programmed budget and time frames identified in the 1986 work statement.

3225 (DOE/BP—868, pp 48-71) **Oak Grove Fork Clackamas River habitat improvement project.** Medel, R. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

The lower Oak Grove Fork of the Clackamas River is a fifth order tributary supporting depressed runs of coho and chinook salmon, and summer and winter steelhead. Stream flow is regulated for power production all year. The stream contributes less than 10% of the low flow of the Clackamas River at their confluence. Virtually the entire low flow of the Oak Grove Fork is diverted at Harriet Dam to the Three Lynx Power Station, operated by Portland General Electric (PGE). Habitat conditions rating for the lower Oak Grove Fork is good, but smolt production estimates are below the average for Clackamas River tributaries. Limiting factors include the lack of quality rearing habitat and heavy channel scour resulting from periodic high flows. Quantity and distribution of spawning gravel are viewed as a secondary limiting feature. 1986 was the second year of a multi-year effort to improve fish habitat in the lower Oak Grove Form and increase anadromous fish production. Habitat improvement activities included channel treatment of a 1650 foot section of the stream immediately below the Hwy 224/FS Road 46 bridge crossing, and the development of a 1050 foot long side channel through placement of a diversion structure locat-

ed 2000 feet upstream from the bridge. The side channel development resulted in excavation and placement of 9 log sill structures and rearing ponds. Approximately 1825 square yards of excellent perennial rearing habitat was created by the side channel. Baseline assessment stations were established for these two project reaches. Each will be evaluated through and following the 1986-87 high flow period. Additional habitat improvement work is planned for 1988 and beyond.

3226 (DOE/BP—868, pp 72-140) **Lake Branch/West Fork Hood River habitat improvement project.** MacDonald, K.; Hutchinson, C.S. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

The Lake Branch/West Fork Hood River habitat improvement project, in 1986, was in the fourth year of a coordinated effort between the Oregon Department of Fish and Wildlife (ODFW), and the USDA Forest Service, Mt. Hood National Forest, to improve anadromous fish production in the West Fork Hood River drainage. The project has been divided into three sub-projects: 1) Lower Lake Branch rearing habitat enhancement; 2) Upper Lake Branch channel rehabilitation, and; 3) West Fork Hood River habitat enhancement. During 1986, activities in lower Lake Branch primarily involved assessment of past habitat improvement work and planning future project activities. Activities in upper Lake Branch centered on planning a channel rehabilitation project to provide year-round rearing habitat in a stream reach that currently flows subterranean in summer. This improvement activity is scheduled for implementation in 1987. Project design and environmental assessment was completed in March, 1987. Past project work in upper Lake Branch was also assessed. Emphasis in the West Fork Hood River drainage was on project implementation in McGee Creek, a tributary stream. Log structures, including sills, wings and diggers were placed at 19 sites. Additionally, six large trees were felled in McGee Creek at sites lacking heavy equipment access.

3227 (DOE/BP—868, pp 141-181) **Fifteenmile Basin habitat improvement project.** MacDonald, K.; Hutchinson, C.S. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

The Fifteenmile Basin habitat Improvement Project is an ongoing multi-agency effort to improve habitat in the Fifteenmile drainage and increase production of the depressed wild, winter steelhead run. Primary activities involved habitat improvement work on Ramsey Creek; and continuation of physical and biological baseline data collection, spawning ground surveys and macroinvertebrate sampling on Fifteenmile, Eightmile, Fivemile and Ramsey Creeks. A draft Fifteenmile basin fish/habitat management implementation plan has been developed by the cooperating agencies. It identifies the goals and objectives of the basin improvement program, identifies project opportunities, priorities those opportunities, and provides for coordinated implementation of the program throughout the basin. The primary project objectives of implementation activities on Ramsey Creek were to increase juvenile rearing habitat and enhance passage at the road 4450 culvert. Log structures including sills, diggers, wings and diagonal series were placed at 24 sites. A total of 27 structures were constructed. Project implementation will continue on Ramsey Creek in 1987 along with continued watershed evaluation and identification of enhancement needs throughout the basin.

3228 (DOE/BP—868, pp 182-264) **Aquatic ecosystem analysis for selected streams on the Mt. Hood National Forest.** Mangum, F.A. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

This report is based upon 84 aquatic macroinvertebrates samples from fifteen stations on six streams, along with physical and chemical data provided by aquatic specialists. Streams monitored as part of an action plan to improve aquatic ecosystems used as spawning and rearing areas by anadromous fisheries, particularly steelhead, were: Dry Creek, Eight Mile Creek, Fifteen Mile Creek, Five Mile Creek, Mays Canyon Creek, and Ramsey Creek.

3229 (DOE/BP—868, pp 265-325) **Fifteenmile Basin habitat enhancement project.** Smith, R.C.; Short, G.W. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

A physical stream survey of the Fifteenmile Creek Basin was conducted to determine limiting factors to wild winter steelhead production. These factors were found to be, upstream and downstream passage problems, the lack of suitable rearing habitat, lethal water temperatures, low summertime flows and poor water quality due to high silt input. Baseline biological data was collected to assess the effectiveness of fish habitat enhancement activities. Data collected includes, water temperature monitoring, flow monitoring and macroinvertebrate collection. The initial phase of the project (Phase I) was to document existing basin deficiencies for winter steelhead production and to provide a management plan to address the solutions to these problems.

3230 (DOE/BP—868, pp 326-393) **Monitoring and evaluation of Mt. Hood National Forest stream habitat improvement and rehabilitation projects.** Higgins, B.; Forsgren, H. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

In the summer and fall of 1986 the Mt. Hood National Forest continued its fish habitat monitoring and evaluation program. This included: pre-treatment baseline data collection on 10 streams scheduled for future improvement work and post-treatment monitoring-evaluation on 5 streams with recently completed habitat work. Methods included an extensive survey of stream habitat condition and types in the project drainages and an intensive physical and biological mapping of 200 foot sample section in the treatment areas. Control sections outside the treatment area were also intensively mapped. Baseline monitoring of the pre-treatment project areas revealed them to be heavily (>80%) dominated by riffle habitats. The project areas contain little in-stream structure, typically provided by large woody debris and boulders, and have low habitat diversity and complexity. Salmonid population estimates in the pre-treatment areas ranged from 0.04/m2 to 0.60/m2. Salmonid population estimates in post-treatment areas ranged from 0.06/m2 to 1.06/m2. The post-treatment densities were typically higher than sampled densities from these areas prior to enhancement work. Control sites did not show similar increases in densities. Generally, the increase was most noticeable in 1+ and older rainbow/steelhead trout, the target population for much of the work. Utilization of the added structure and the associated new habitats appeared high. Evaluation of more than 600 habitat improvement structures following a flood event with a 15 to 25 year return interval, identified a number of factors which influence the durability and performance of in-stream structures.

3231 (DOE/BP—868, pp 394-439) **Grande Ronde habitat improvement project: Joseph Creek and Upper Grander Ronde River drainages.** Williams, S.H.; Reece, A.L.; Noll, W.T.; Reeve, R.N. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

This project's primary objective is to provide additional spawning and rearing habitat for summer steelhead and spring chinook, thereby increasing smolt production and complimenting ongoing efforts to restore Columbia and Snake River stocks. This project provides for implementation of Program Measure 704 (d) (1) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program and will be done as off site mitigation for mainstem fishery losses caused by the Columbia River hydro-electric system. All work being done by the Oregon Department of Fish and Wildlife is on private lands and therefore requires considerable time be spent developing landowner rapport to insure their acceptance of, and cooperation with, the program. During 1986, leases were signed with three landowners which will protect 6.8 miles of stream and 106.6 acres of riparian habitat. At the close of 1986 an additional five leases were being negotiated. Fencing, planting, instream structure work, and habitat inventories were all

undertaken during 1986; construction of 1.9 miles of fence, maintenance of 4.4 miles of fence, instream work on 3.6 miles of stream, planting of 0.6 miles of stream, and inventorying 119.4 miles of stream were all completed in 1986.

3232 (DOE/BP—868, pp 448-475) **Grande Ronde river habitat enhancement on the Wallowa-Whitman National Forest.** Thomas, S.; Leonard, M.; Miller, R.; Uberuaga, R. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

Fisheries habitat inventory was completed along 23.1 miles of stream in the Meadow Creek sub-basin. Instream structure enhancement design was also completed along 7.6 miles of Fly Creek. Instream structure installation along the mainstem Grande Ronde River was deferred until the 1987 field season du to extreme summer fire activity. Riparian fencing along sheep Creek was 90% complete by the field season's end. On hundred and one instream structures along Sheep Creek (1985) received minor maintenance during this field season.

3233 (DOE/BP—868, pp 476-487) **Middle Fork John Day River and tributaries habitat improvement.** Gritz, R. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

Two projects were completed in 1986. Project 1, involved structural fish habitat improvement work on five tributaries of the Middle Fork John Day River. The work included the installation of log and rock weirs, log and rock deflectors, riprap blankets, and boulders, as well as relocating the stream back into its natural channel in two locations. Maintenance of existing structures on other tributaries was also accomplished. Project 2, was the survey, environmental analysis, and preliminary design work for future projects on remaining tributaries to the Middle Fork. The primary objective of the structural work this year was to increase the quantity and improve the quality of steelhead rearing habitat in Beaver Creek, Big Boulder Creek, Davis Creek, Vincent Creek, and Vinegar Creek. Chinook rearing potential will also be increased. Barriers to fish movement during low flow conditions are also a concern in Vincent Creek and Vinegar Creek. In the spring, several small poorly defined channels were present, but none of these channels were able to maintain flow through the summers of dry years. Structural work in these areas was to help the stream define and maintain a main channel with enough size and depth to maintain surface flow during low flow conditions. Two changes were made to the 1986 program of work during final layout. First, Beaver Creek was substituted for the tributaries of Big Boulder Creek. Second, Vinegar Creek was substituted for Deerhorn Creek. In related Forest Service projects, the resource survey of the South Fork John Day River and tributaries on the Malheur National Forest, which was started in 1985, was completed. Maintenance of existing fish habitat and passage structures was also accomplished.

3234 (DOE/BP—868, pp 488-519) **John Day River fish habitat enhancement.** Stuart, A.; Lacy, M.; Williams, S. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

This project provides initial landowner contacts agreement development, project design, budgeting, and implementation for an anadromous fish habitat improvement program on privately owned lands within the John Day Basin. The purpose of the project is to provide off site mitigation for spring chinook and summer steelhead adult and juvenile losses from hydroelectric dams on the Columbia River. Implementation of the major segment of improvement work in 1986 occurred after July 1. Activities under the first phase of the contract period included landowner contacts and agreement development, personnel training, equipment purchase, physical habitat inventory, planning and design, and construction contract development. Activities in the second phase included layout of contract work and contract implementation, physical habitat inventory and photopoints, construction of instream structures and riparian fence, budget development, annual report, and landowner contacts for 1987 work. Instream habitat improvement was completed on 4 miles of the mainstem John Day River and included construction of 3.5 miles of riparian exclosure fence. Approximately 2.8 miles of fence was completed on 1.7 miles of stream on 2 reaches of the mainstem where rock work was completed in 1985. Construction included completion of 5 miles of instream habitat improvement and 11.4 miles of barbwire exclosure fence on Fox Creek. A passage improvement project for steelhead was partially completed on an 8′ waterfall barrier on Deer Creek.

3235 (DOE/BP—868, pp 520-583) **North Fork John Day River habitat improvement.** Frazier, B.D.; Fishburn, E.; Metz, R. Jan 1986. NTIS, PC A25/MF A01. Order Number DE87014620/JAW.

In Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.

In 1986, the Umatilla National Forest constructed fish habitat improvements on the North Fork of the John Day River and side channels, Desolation Creek, Wilson Creek, Little Wall Creek, and North Hidaway Creek. Work in the North Fork John Day River and side channels consisted of opening 1 new side channel, constructing 46 side channel and 9 mainstem rock weirs, constructing 52 rock deflectors to direct flow in side channels and control bank erosion, planting 672 cuttings, and placing 160 large boulders and 26 logs in side channels and in the main river to provide instream cover. Work on Desolation Creek created an estimated 5500 square meters of quality rearing pool habitat by constructing 72 rock and 7 log weirs and 7 rock and log deflectors in 0.8 miles of the stream. In addition, 0.6 miles of side channels were constructed and 191 boulders and 40 logs were placed in the stream and 38 hardwood cuttings were planted. In Wilson Creek during 1986, the authors constructed 103 rock weirs, sills and berms, and 9 log weirs for a total of 111 major pool creating structures for juvenile rearing. Fish passage was improved by some stream channel construction. In Little Wall Creek During 1986, 1 rock weir, 22 log weirs, and one rock sill were constructed; and 5 root wads, one log deflector and 2 rock deflectors were placed. Some stream channel reconstruction was also completed. The Forest constructed 20 pool-creating log and rock weirs, placing woody material in each, and placed 20 boulders and logs in North Hidaway Creek. Some stream channel reconstruction was completed.

1307 Power-conversion Systems

3236 **(EPRI-AP—5382) The use of nonasbestos friction materials in hydrogenerators: Final report.** McNaughton, W.P.; Richman, R.H.; Beaupre, G.S.; Whalen, R.T. (Daedalus Associates, Inc., Mountain View, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 124p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920063/JAW.

This report presents the state-of-the-art and outlook for asbestos-free friction materials for use in hydroturbine brake applications. Within the period of the study, development activities culminated in the commercial availability of several asbestos-free formulations. The emphasis in this report is a practical exposition of the requirements for friction materials in hydroturbines, the general classes of alternatives, the experience base with substitutes in the hydro industry and in other industries, a review of qualification and standards of performance for friction materials, a listing of sources for asbestos-free products, and a summary of other issues surrounding asbestos and asbestos substitutes. This report should provide guidance for specifying either original equipment or replacement brake materials. The background to alternative material types and bounding calculations of important operating parameters are also included. 49 refs., 10 figs., 12 tabs.

3237 **(OH/R—86/315/K) Alexander G.S. [Generating Station] Units 2 and 4. Turbine performance tests. Electrical results.** Fischer, W.S. (Ontario Hydro, Toronto (Canada). Research Div.). 22 Jan 1987. 5p. (MICROLOG—87-04197). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Turbine Performance Tests were conducted at Alexander Generating Station on October 1st and 2nd, 1986. The electrical test results are contained in this report and have been corrected for all metering errors, except those which may originate in the station instrument current and potential transformers.

3238 **(OH/R—86/327/K) Polymer inspection program marine junction. Otonabeets 1986 visual inspection program.** Chisholm, W.A.; Murphy, D.E. (Ontario Hydro, Toronto (Canada). Research Div.). 6 Jan 1987. 4p. (MICROLOG—87-04193). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A long-term program to monitor the performance of 20-kip long-rod polymer insulators was set up in 1983. A test line of 12 double-circuit 230kV towers was insulated with over 100 units and energized at normal line voltage. Annual visual and corona inspections have been conducted. This inspection revealed the first visual signs of degradation: brown marks appeared on one of the dead-end units of Tower 1. Otherwise, the insulators are still in good condition.

14 SOLAR ENERGY

1401 Resources And Availability

REFER ALSO TO CITATION(S) 4272

3239 **(PB—87-220174/XAB) Calendar year 1985 solar and weather data for Austin, Texas. Research report.** Sloan, C.M.; Vliet, G.C.; Hunn, B.D. (Texas Univ., Austin (USA). Center for Energy Studies). Mar 1987. 245p. (CONSERV-SOLAR-RR—3). NTIS, PC A11/MF A01.

The Department of Mechanical Engineering and the Center for Energy Studies at the University of Texas at Austin maintain a monitoring station on the roof of the Engineering Teaching Center that provides measured solar and weather data for Austin, Texas. The station has been operational since July 1, 1984, and provides hourly data for the following: (1) global horizontal solar radiation; (2) direct-beam solar radiation; (3) calculated diffuse horizontal solar radiation; (4) measured diffuse horizonal solar radiation; (5) clearness index; (6) wind speed; (7) wind direction; (8) dry-bulb temperature; and (9) relative humidity. The report describes the solar/weather station and the calibration of its instruments, and details the methodology developed for quality control and editing of the measured data.

3240 **Joint EPRI-SERI spectral solar radiation database project.** Riordan, C. (Solar Energy Research Institute, Golden, CO). *Solar Cells;* **21**: 337-342(Aug 1987).

The Solar Energy Research Institute (SERI), the Electric Power Research Institute (EPRI), the Pacific Gas and Electric Company (PG&E) and the Florida Solar Energy Center (FSEC) are cooperating to develop a spectral solar irradiance database to meet the needs of the photovoltaic (PV) community. The common objective is to develop a spectral solar irradiance database for a range of air masses and atmospheric conditions (or climates). Spectral irradiance, broad band irradiance (insolation) and meteorological data will be collected at several sites in the U.S.A. and archived at SERI in a common format. These data will be used at SERI to develop and verify spectral irradiance models that will predict the spectral irradiance environment from available insolation and meteorological data, and thereby expand the database. The expected result is a spectral irradiance database that will be available to the PV community in 1-2 years'time.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 3204, 3205, 3208, 3211, 3212, 3214, 3215, 3216, 3260, 4441

3241 **(AD-A—183510/7/XAB) Conduction mechanisms in radiation-damaged MINP Si solar cells. Technical report No. 7, 1 August 1986-31 July 1987.** Banerjee, S.; Anderson, W.A. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). Dec 1986. 12p. NTIS, PC A02/MF A01.

Pub. in IEEE Transactions on Nuclear Science, Vol. NS-33, No. 6, 1474-1481(Dec 1986).

Current-voltage characteristics of e(-) irradiated silicon MINP solar cells were studied as a function of temperature to understand the radiation-induced enhancement in the dark current. The devices show efficiences about 16% and excellent junction properties before irradiation. The conduction mechanisms in as fabricated devices have been recognized as diffusion and recombination in the space charge region through deep centers. However, current conduction was found to be dominated by the presence of shallow defect centers in the space charge layer after the devices were irradiated at 1 MeV e(-) to a final fluence of 10^{16} e(-)/cm^2. Some of the defect levels have been associated with structural damage and caused by the irradiation.

3242 **(BMFT-FB-T—86-187) Development of highly efficient and economic systems for the photovoltaic use of solar energy. Final report.** Arndt, W.; Bauer, G.H.; Bilger, G.; Bloss, W.H.; Dimmler, B.; Dittrich, H.; Hewig, G.H.; Kimmerle, J.; Menner, R.; Mohring, H.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Physikalische Elektronik). Dec 1986. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750151/JAW.

The programme of the project covers R and D of amorphous and polycrystalline thin films for single-junction- and tandem solar cells. In continuation of the project 03E-4045-B and in cooperation with the company NUKEM, Hanau, research has been carried with the goals cost reduction and improvement of contacting technology and efficiency of Cu/sub 2/S-CdS solar cells. Concerning a-Si solar cells alternative doping methods have been studied. The PAD-method originally developed for B-doping might be an alternative to conventional methods. Definite variations of the optical bandgap of amorphous semiconducting alloys have been achieved by admixture of C or N and of Ge or Sn for higher and lower bandgaps, respectively. However, the carrier lifetime decreases with increasing amounts of C, N, Ge or Sn in the amorphous network. For alternative polycrystalline thin film solar cells and tandem structures binary and ternary II-VI-compound- and chalcopyrite thin films have been studied, with the emphasis on the junctions CuInSe/sub 2/-(Zn,Cd)S and - for the front cell in thin film tandem systems - ZnTe-(Zn,Cd)S, pn-Zn(Se,Te), and CuGaSe/sub 2/-(Zn,Cd)S. The latter heterojunction at present is considered to be the most promising system. With 121 refs., 3 tabs., 111 figs.

3243 **(CFS/HQ—8610) Summary of federal forest lands in Canada.** Woods, R.A. (Canadian Forestry Service, Hull, Quebec). Oct 1986. 91p. (In English and French). (MICROLOG—87-03214). Canadian Forestry Service, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, Ont., Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This report is the first of its kind to summarize on a national basis the forest resources on federal lands in Canada. It has particular reference to forestry and for the most part the following constraints apply: in order to be included in the report, Indian Reserves generally have at least 20 ha of productive forest land; most other federal properties contain at least 100 ha of productive forest. National Historic Sites and national wildlife reserves are not includ-

ed. Public lands under federal government administration account for approximately 25 percent of all forested lands in Canada. However, much of this consists of large tracts of marginal and unproductive forests that occur in the Yukon and Northwest Territories. Of productive forests, the federal share drops to approximately ten percent. The areas of federal lands and their productive forests are summarized by province.

3244 **(CFS/OO—8606) Manual of forest inventory guidelines for federal and Indian lands.** Hirvonen, R.; Woods, R.A. (eds.). (Department of the Environment, Ottawa, Ontario (Canada). Canadian Forestry Service). Jun 1986. 159p. (In English and French). (MICROLOG—87-03199). Canadian Forestry Service, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, Ont., Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

The Canadian Forestry Service (CFS) is involved in a variety of forest management activities that may occur on properties subject to a number of different regulat , jurisdictional, and ownership-administrative frameworks. Added to this is the great diversity of Canada's forests. Accordingly, forest inventories can differ considerably among different parts of the country. To attain a basic level of consistency to these inventories, to ensure fundamental standards of performance, and to meet the requirements of the Canadian Forest Resource Data System, it is necessary that the CFS adopt a set of guidelines within which forest inventories are implemented for all lands the CFS manages or provides funds for managing. The guidelines are intended to be broad enough to permit local flexibility and innovation. This manual provides guidelines for the contents and procedures to be followed in planning, implementing, and reporting on these inventories.

3245 **(CFS/OO—8607) Manual of forest management plan guidelines for federal and Indian lands.** Hirvonen, R.; Woods, R.A. (Department of the Environment, Ottawa, Ontario (Canada). Canadian Forestry Service). Jul 1986. 94p. (In English and French). (MICROLOG—87-03198). Canadian Forestry Service, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, Ont., Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This manual provides guidelines on the contents and procedures for forest management plans produced for federal and Indian lands and for other land funded by the Canadian Forestry Service (CFS). It is a checklist of requirements for project development and implementation. The guidelines are meant to function within local requirements, methods, and standards and to ensure that CFS administered or funded forest management plans attain adequate minimum standards.

3246 **(CFS/VBC/PFC—BC-X-289) The economics of residual fuel and fibre production on the British Columbia coast.** Nagle, G.S.; Massie, M.R.C.; Robinson, G.; Oakley, P.; Manning, G.H. (Canadian Forestry Service, Victoria, British Columbia. Pacific Forestry Centre). 1987. 59p. (MICROLOG—87-04371). Canadian Forestry Service, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, Ont., Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

ENFOR is the acronym for the Canadian Government's ENergy from the FORest (ENergie de la FORet) program of research and development aimed at securing the knowledge and technical competence to facilitate in the medium to long term a greatly increased contribution from forest biomass to the country's primary energy production. The Canadian Forestry Service administers the ENFOR Biomass Production program component that deals with such forest-oriented subjects as inventory, harvesting technology, silviculture, and environmental impacts. The potential for a residual wood fibre industry on the B.C. coast was investigated using a simple model that includes the amount of residual fibre available, the cost of extracting and processing the fibre using ten different systems, the expected demand for that fibre in light of several oil price scenarios up to the year 2000, transportation costs, and other economic factors. Under the conditions assumed in this study, there is a potential for a residual wood fibre industry on the B.C. coast. Such an industry could employ 300 to 570 people and could provide between $9 and $17 million in wages. The economic impact of such a new industry on the region is discussed. 37 figs., 18 tabs.

3247 **(CONF-8706209—1) Development of a research strategy for poplar.** Wright, L.L.; Layton, P.A.; Ranney, J.W. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014060/JAW.

From Poplar Council of the United States meeting; Syracuse, NY, USA (21 Jun 1987).

A research plan is presented which focuses on an exemplary wood energy production system as part of a biofuel pathway leading to liquid fuels. This system is designed to achieve productivity levels of 20 Mg ha^{-1} $year^{-1}$ under operational conditions in the Pacific Northwest, North Central and the Northeast portions of the United States utilizing poplar clones with wood qualities that will facilitate the conversion of these materials to liquid fuels. The Short Rotation Woody Crop Program (SRWCP) is channeling over one-half of its resources into research on poplar species. Of the species now being investigated by the poplar genera is considered highest priority. Until now the SRWCP research on poplar has proceeded somewhat independently at several different institutions. A meeting of all poplar researchers currently associated with the SRWCP, and the SRWCP field management staff, was held in May 1987 with the specific purpose of knitting together all participants into a group which will be referred to as the "Energy Consortium" or "EPC". The meeting resulted in agreements on prioritization of current research, significant research needs not currently being met, and potential areas for coordination of research between individuals and institutions. Examples include: (1) the agreement that reducing Septoria incidence through all means available is high priority, and (2) the decision to encourage Iowa State University to take the lead in developing a breeding strategy for poplar improvement in the North Central regions. 1 ref., 2 figs., 2 tabs.

3248 **(DOE/JPL/956614—1) Investigation of silicon surface passivation by silicon nitride film deposition: Final report, September 1, 1983-August 31, 1986.** Olsen, L.C. (Joint Center for Graduate Study, Richland, WA (USA)). Sep 1986. Contract NAS-7-100-956614. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE87014403/JAW.

During this last (3rd) year of the program, efforts concentrated on SiN/sub x/ passivation studies. In particular, the key objectives were: relate the density of states at SiN/sub x//Si interfaces to the substrate dopant concentration; characterized the SiN/sub x//Si interface on high efficiency cells; and identify dominant current loss mechanisms in high efficiency cells. The interface state density (D/sub ss/) at the SiN/sub x//Si interface of Al/SiN/sub x//Si MIS structures was determined using high frequency and slow ramp capacitance-voltage (C-V) measurements. Values of D/sub ss/ were obtained for a range of substrate resistivities, and for both N- and P-type material. The surfaces of high efficiency N/P and P/N solar cells were characterized by using a special structure which allows simultaneous measurement of the interface recombination velocity. Dominant current loss mechanisms were determined from temperature dependent I-V analyses. The remainder of this report consists of discussions of the following: surface characterization of homogeneously doped substrates and solar cells; studies of high efficiency cells; and conclusions concerning this year's effort.

3249 **(EMR/B—8701) Strategic plan for bioenergy R and D.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Bioenergy Div.). Jan 1987. 38p. (MICROLOG—87-04145). Bioenergy Division, Energy, Mines and Resources Canada, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Biomass is an energy resource (bioenergy) that provides Canada with a cost-effective, sustainable, and environmentally acceptable alternative to depleting conventional fossil fuels. Bioenergy currently contributes over 6.5% (approximately 550 PJ/a) of

Canada's primary energy supply. Bioenergy is defined as useful energy derived from biomass; this includes all matter derived directly or indirectly from forest, agricultural, and aquatic sources, as well as municipal solid waste and peat. Chemically, it is extremely versatile in its ability to be transformed into a wide variety of end-uses. The versatile characteristics of biomass lend themselves to achieving the practical goal of providing alternative energy forms that can be integrated with conventional energy products. This report outlines strategies for bioenergy research responding to Canada's continuing objective of increased energy security in both the short and long term, as well as to a national objective of encouraging economic growth in the energy sector.

3250 **(ETSU-B—1051-Pt.1) Experimental studies on catch fuel crops. Technical report part 1.** Spedding, C.R.W.; Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Aug 1980. 153p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the first year of an experimental study on catch fuel crops in the UK. The basic objectives were to provide an estimate of potential UK production by assessing the efficiency of use of the resources available. Particular emphasis is placed on productivity and the effects of environment and management on productivity. A strategy is proposed for the longer term research program.

3251 **(ETSU-B—1051-Pt.2) Experimental studies on catch fuel crops. Technical report Part 2.** Spedding, C.R.W.; Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Aug 1980. 55p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the first year of an experimental study on catch fuel crops in the UK. The report concentrates on the selection of a genotype for the catch fuel crop system and outlines the various options for management and their likely effect on overall efficiency. Areas for further consideration are outlined as well as recommendations for further study.

3252 **(ETSU-B—1051-Pt.3) Experimental studies on catch fuel crops. Management summary.** Spedding, C.R.W.; Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Aug 1980. 25p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the first year of an experimental study on catch fuel crops in the UK. After outlining the background, the objectives of the study are defined, i.e. to examine the productivity and technical and economic feasibility of catch fuel crop systems. The report concentrates on conceptual studies and field experiments with particular emphasis on productivity. Further theoretical and experimental investigations are suggested.

3253 **(ETSU-R—35) Review of the potential for catch crops and native vegetation as fuel in the UK.** Brandon, O.; Price, R. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Aug 1985. 71p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The results from a series of studies commissioned by ETSU to investigate the potential for energy crops other than wood are summarised. One major study examined the production of agricultural catch crops, while a second was concerned with the growth and harvesting of native and naturalised vegetation. In each case the potential for economic energy production through anaerobic digestion or combustion of the biomass was investigated. Neither catch crops nor natural vegetation seem likely to contribute significantly to the UK national energy supply in the near future, and no further research in this area is planned.

3254 **(GAO/RCED—86-59) Biotechnology: Agriculture's regulatory system needs clarification.** (General Accounting Office, Washington, DC (USA)). 1986. 73p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Biotechnology includes any technique that uses living organisms to make or modify products, to improve plants or animals, or to develop microorganisms for specific uses. It involves new, nonsexual techniques enabling man to move genes from one organism to another, related or unrelated. The Department of Agriculture has not formulated a well defined regulatory structure concerning deliberate releases of genetically engineered organisms into the environment. It has done little to communicate to the Congress and the public both the benefits and risks of biotechnology as well as its plans to minimize those risks.

3255 **(LBL—23915) Terpenoid biosynthesis in Euphorbia lathyris and Copaifera spp.** Skrukrud, C.L. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001463/JAW.

Biosynthesis of triterpenoids by isolated latex of Euphorbia lathyris was investigated. The rate of in vitro incorporation of mevalonic acid into triterpenoids was thirty times greater than acetate incorporation indicating that the rate-limiting step in the pathway occurs prior to mevalonate. Both HMG-CoA reductase (EC 1.1.1.34) and HMG-CoA lyase (EC 4.1.3.4) activities were detected in isolated latex. HMG-CoA reductase was localized to a membrane-bound fraction of a 5000g pellet of latex. The rate of conversion of HMG-CoA to mevalonate by this enzyme is comparable to the overall rate of acetate incorporation into the triterpenoids suggesting that this enzyme is rate-determining in the biosynthesis of triterpenoids in E. lathyris latex. HMG-CoA reductase of E. lathyris vegetative tissue was localized to the membrane-bound portion of a particulate fraction (18,000g), and was solubilized by treatment with 2% polyoxyethylene ether W-1. Differences in the optimal pH for activity of HMG-CoA reductase from the latex and vegetative tissue suggest that isozymes of the enzyme may be present in the two tissue types. Studies of the incorporation of various precursors into leaf discs and cuttings taken from Copaifera spp. show differences in the rate of incorporation into Copaifera sesquiterpenes suggesting that the site of sesquiterpene biosynthesis may differ in its accessibility to the different substrates and/or reflecting the metabolic controls on carbon allocation to the terpenes. Mevalonate incorporation by Copaifera langsdorfii cuttings into sesquiterpenes was a hundred-fold greater than either acetate or glucose incorporation, however, its incorporation into squalene and triterpenoids was also a hundred-fold greater than the incorporation into sesquiterpenes. 119 refs., 58 figs., 16 tabs.

3256 **(SAND—87-7009) Development of mechanically stacked tandem concentrator cells.** Cape, J.A.; Fraas, L.M.; McLeod, P.S.; Partain, L.D. (Chevron Research Co., Richmond, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001926/JAW.

Mechanically stacked, multijunction (MSMJ) solar cells offer an excellent prospect for significantly increased efficiencies in the near term. In this work, we examine several new concepts for a MSMJ solar cell. These MSMJ cell concepts include the following: A GaAsP cell grown on a GaP substrate for stacking onto a silicon cell; a GaSb cell grown lattice-matched on a GaSb substrate for stacking beneath a GaAs cell; and a Ge cell for stacking beneath a GaAs cell. The growth of GaAsP and of GaSb by vacuum chemical epitaxy and the development of GaSb solar cells are described. The development of a germanium solar cell and of a 26.1% GaAs/Ge MSMJ cell is also described. Finally, this work has identified approaches for achieving efficiencies with a MSMJ cell in excess of 30%. 19 refs., 18 figs., 7 tabs.

3257 **Influence of microstructure on the Urbach edge of amorphous SiC:H and amorphous SiGe:H alloys.** Mahan, A.H.; Menna, P.; Tsu, R. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **51**: No. 15, 1167-1169(12 Oct 1987). Contract AC02-83CH10093.

Infrared measurements have been used as a means of quantifying the amount of hydrogenated amorphous silicon and amorphous silicon alloy microstructure. Using a parameter obtained from these infrared measurements, the Urbach edge of amorphous

silicon (a-Si:H), amorphous silicon carbon (a-SiC:H), and amorphous silicon germanium (a-SiGe:H) obtained from photothermal deflection spectroscopy measurements fall on the same curve. This suggests that the decreasing steepness of the Urbach edge, observed to occur with increasing alloying, is due primarily to microstructural effects and not to increased structural or compositional disorder. Based upon this correlation, we suggest an explanation for the observed decrease in alloy material photoconductivity with increasing alloy content.

3258 **Mating system and basidiospore formation in the lignin-degrading basidiomycete Phanerochaete chrysosporium.** Alic, M.; Letzring, C.; Gold, M.H. (Oregon Graduate Center, Beaverton). *Applied and Environmental Microbiology;* 53: No. 7, 1464-1469(Jul 1987). Contract FG06-86ER13550.

Prototrophic strains recovered from crosses between auxotrophic strains of the lignin-degrading basidiomycete Phanerochaete chrysosporium were induced to fruit. The progeny of most of these self-crosses were prototrophic, indicating that the nuclei of the original prototroph were wild-type recombinants rather than complementary heterokaryons and that the binucleate basidiospores of this organism are homokaryotic. Various wild-type strains were shown to have multinucleate cells lacking clamp connections and to possess a variable number of sterigmata per basidium. Colonies arising from single conidia of various wild-type strains were all capable of producing fruit bodies and basidiospores. In addition, single basidiospores from three wild-type strains all produced fruit bodies and basidiospores. Nonfruiting as well as fruiting isolates were obtained from single basidiospores of five other wild-type strains. Basidiospores from these fruiting isolates always yielded colonies that fruited, again indicating that the spores are homokaryotic. Nonfruiting isolates from the same strain did not produce basidiospores when allowed to form a heterokaryon, implying that these isolates do not represent mating types. All this evidence indicates that P. chrysosporium has a primary homothallic mating system. In addition to fruiting and nonfruiting phenotypes, basidiospores from strain OGC101, a derivative of ME-446, gave rise to colonies which did not grow on cellulose (Cel^-). The fruiting, nonfruiting, and Cel^- phenotypes differed from each other and from the parental wild-type strain in a variety of characteristics, including growth, conidiation, and evolution of $^{14}CO_2$ from ^{14}C-side chain-labeled lignin, indicating that strain OCG101 is a heterokaryon.

3259 **Bacteriopheophytin g: properties and some speculations on a possible primary role for bacteriochlorophylls b and g in the biosynthesis of chlorophylls.** Michalski, T.J.; Hunt, J.E.; Bowman, M.K.; Smith, U.; Bardeen, K.; Gest, H.; Norris, J.R.; Katz, J.J. (Argonne National Lab., IL). *Proceedings of the National Academy of Sciences of the United States of America;* 84: No. 9, 2570-2574(May 1987).

Bacteriopheophytin g and small amounts of bacteriochlorophyll g have been obtained in high purity from the recently discovered photosynthetic bacterium Heliobacterium chlorum. Preparative methods and precautions in handling these sensitive compounds are described. The compounds have been characterized by californium-252 plasma desorption mass spectrometry, HPLC, visible absorption, and electron spin resonance spectroscopy. The results agree with the structure of bacteriochlorophyll g advanced by H. Brockmann and A. Lipinski, with the exception that the present authors find the esterifying alcohol to be farnesol and not geranylgeraniol as originally suggested. Zero field splitting parameters of triplet state bacteriopheophytin g and the ESR properties of the cation free radical of bacteriochlorophyll g are reported. The photoisomerization of the subject compounds has been studied. Bacteriopheophytin g undergoes photoisomerization in white light to pheophytin a with a half-time of ~42 min. They suggest that all of the chlorophylls are biosynthesized from a common intermediate containing an ethylidine group, double bond CH single bond CH_3, such as it present in bacteriochlorophylls b and g.

1406 Photovoltaic Power Systems

3260 **(BMFT-FB-T—86-212) Technical applications of solar energy. Project 'Photovoltaic systems'. Final report.** Herrmann, B.; Honstetter, K.; Karl, H.; Kopf, E.; Lehner, G.; Yu Shi Jie. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Theorie der Elektrotechnik). Dec 1986. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750014/JAW.

The report deals with the development of equipment for investigations on photovoltaic systems (test facility for photovoltaic water pumping systems, device for measuring the characteristics of PV generators, simulator for PV modules), models for system simulation, photovoltaic water pumping systems (experiments and computer simulation) and small scale photovoltaic cooling systems.

3261 **(SAND—87-0353) Design and development of a 4-kW/2-kHz dc-isolated power conditioner for utility-interactive photovoltaic applications.** Cocconi, A.; Cuk, S.; Middlebrook, R.D.; Key, T.S. (TESLAco - Optimum Power Conversion, Inc., Pasadena, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001934/JAW.

A utility-interactive inverter based on high-frequency isolation has been developed to provide a low-cost, compact, photovoltaic-to-utility interface at the residential power level of 4 kW. A single-quadrant, dc-isolated, push-pull buck converter switching at 20 kHz is used to generate a full-wave rectified sine wave that is subsequently unfolded by a low-speed, four-transistor bridge to result in a 60-Hz sine wave power output. A control strategy optimizing the output impedance of the inverter for the direct interface to the stiff utility voltage has been developed. A novel peak power tracking circuit based on the inherent 120-Hz input voltage ripple continuously follows the peak power without artificial operating point dither. Inverter shut-down after line disconnection is ensured, fully protecting the serviceman, even when the solar power available exactly matches a unity power factor load. Despite its low weight of only 17 kg, the inverter is 92% efficient. 5 refs., 60 figs., 7 tabs.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 3268, 3272

3262 **(BMFT-FB-T—86-211) Kuwait, Phase 3 B. Extension of the existing solar power plant by a process heat generation system, and connection of a multi-stage desalination plant for process heat utilization. Final report.** Raasch, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Raumfahrt). Dec 1986. 157p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750134/JAW.

1) Objectives: Recovery of the waste heat of the Organic Rankine Cycle of a thermal solar power plant as process heat and consumption of the obtained heat by a thermal user. 2) Work program: 2.1 Layout of the plant; 2.2 Procurement and installation of the components; 2.3 Test of the plant. 3) Results: Installation of the waste heat recovery system and of a desalination unit as user of the thermal energy. Testing of the plant system solar power plant/waste heat recovery/desalination unit in several test runs, that proved the correctness of the plant layout. With 3 refs., 39 figs., 7 tabs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 3262

3263 (BMFT-FB-T—86-228) Project Daxin. Cooperation program with the P.R. of China. Phase II. Partial project solar and wind energy. Final report. Speidel, K.; Fritzsche, A.; Schneller, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.)). Dec 1986. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750133/JAW.

The cooperation program with Chinese partners can be seen as a joint development program for planning, erection and testing of solar- and wind-powered facilities. These units shall be useful in future in rural areas of the P.R. of China. The main interest is the self-production of these units in the country of application. Following facilities have been planned: Solar-powered thermal water pump, solar-powered water treatment unit to produce drinkable water from surface water, wind energy converter for water pumping, wind energy converter for electricity supply. All facilities have been nearly completed and are in operation for testing. With 27 refs., 44 figs., 6 tabs.

3264 (EEL—8701) Design of cost-effective, reliable solar heating systems. A design guide based on the proceedings of the October 7, 1986 EMR workshop. (Enermodal Engineering Ltd., Waterloo, Ontario (Canada)). Jan 1987. 45p. (MICROLOG—87-03755). Renewable Energy Branch, Energy Mines and Resources Canada, 460 O'Connor Street, Ottawa, Ont., Canada K1A 0E4;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report is a summary of a one-day workshop held in Ottawa. Thirty-six Canadian solar designers discussed techniques for reducing system costs and improving system performance and reliability. Discussion was restricted to liquid-based commercial/industrial solar heating systems. Nine main areas were covered: solar application evaluation, site evaluation, system design, rack design, storage design, heat exchanger selection, control requirements, piping design, and pump/valve selection. The report presents over 50 techniques that can be used to improve cost effectiveness. 7 figs.

3265 (ETSU-S—1130) Refinements to SERI-RES. Haves, P.; Littler, J. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 94p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

In 1981 there was general agreement that it is impractical to substantiate UK energy savings resulting from passive solar design, solely by constructing and monitoring the small number of buildings which can be embraced by a realistic R and D programme. The matrix of building types, occupancy and climatic variation is simply too large. Computer simulation was recommended as a necessary part of this task -models can be used quickly and efficiently to fill the matrix. The SERI-RES simulation model was selected for use within the Passive Solar Programme. Non-geometrical input data; graphical input from scribe modeller, physical realism, output enhancements, the user port and lighting are reviewed.

3266 (ETSU-S—1162) Test cell studies 1. Parameter determination using test cells. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 133p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The report presented comprises separate documents and gives a detailed description of the construction, instrumentation and data acquisition system of the test room facility used by the Energy Monitoring Company Limited for the 'Further Work in Passive Solar Test Rooms' contract awarded by ETSU. The definition of selected inputs for SERI-RES computer model, the influence of window size and room colour on the fraction of incoming solar radiation reflected back out of a room, the way that incoming solar radiation is distributed between the elements of a room and measurement of parameters describing the effect of curtains and venetian blinds are discussed.

3267 (EUR—10313-FR) Analysis of the sensitivity and pertinence of network data: Captor plans in the Paris Basin. Adnot, J.; Bourges, B.; Watremez, G. (Association pour la Recherche et le Developpement des Methodes et Processus Industriels (ARMINES), 75 - Paris (France)). 1985. 66p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900075/JAW.

The Sensitivity of the Results of Performance Computations for Solar Equipment to the quality of Meteorological Data gives information about the systems and the best way for modelling them, and about the pertinence of Available Network Data. The present "Analysis of the Sensitivity and Pertinence of Network Data" is limited to flat-plate collectors. It allowed for the comparison of three models (Reference MINERSOL : R; Inertial : I; Non-Inertial : H) and Data Basis more or less Reduced (measurements every minute or each 6, 30, 60 minutes; Cumulative Frequencies Curves; ...) for two locations of the Parisian Region (Le Landy and Trappes).

3268 (SERI/TR—252-3056) Modeling high-temperature direct-contact heat exchange in an irrigated packed bed. Bohn, M.S. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87012282/JAW.

This report presents an analytical model of direct-contact heat exchange (DCHX) in an irrigated packed bed at high temperatures. The specific application is heat exchange between molten salt and air where the molten salt is a sensible heat storage medium and high temperature air is required for an end process. The model defines several heat transfer mechanisms between the three components in the bed - the liquid, the gas, and the packing. It also includes the effect of conduction in the packing. Correlations found in the literature are used to calculate the associated heat transfer coefficients. The model is restricted to liquids that wet the packing material and to gas/liquid flow rates below the loading point. Three dimensionless equations describe the heat balance between the three bed components. The resulting dimensionless parameters reveal that for commercial DCHX systems, radiation heat transfer is unimportant relative to the convective heat transfer, which is consistent with previous experimental results for air/mercury and nitrogen/molten lead systems. The model also predicts volumetric heat transfer coefficients of about 10,000 W/m^3K, which is consistent with experimental work.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 3262, 3264

3269 (ASE—8702) Ultra light-weight flat plate solar collector performance characterization. Plett, E.G.; Khalil, M.B.; Amrud, K.K. (Asecor Ltd., Manotick, Ontario (Canada)). Feb 1987. 37p. (MICROLOG—87-03751). Renewable Energy Branch, Energy Mines and Resources Canada, 460 O'Connor Street, Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Experimental testing was carried out on Asecor's ultra light-weight flat plate solar collector prototype to determine its thermal performance and flexural rigidity. The thermal performance was evaluated at two tilt angles. The collector's flexural rigidity was evaluated by measuring the deflection of the collector under known loads. Several suggestions are offered for increasing the rigidity of the collector. Performance simulations were run to obtain economic data to evaluate the market potential of the collector. 4 figs., 1 tab.

3270 **(BMFT-FB-T—86-186) Vacuum collector with mirror booster for domestic energy. Final report.** Jaeger, M.; Muehlensiep, J.; Scharmer, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Gesellschaft fuer Entwicklungstechnologie m.b.H., Aldenhoven (Germany, F.R.)). Dec 1986. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750136/JAW.

The heat gain of highly evacuated flat plate collectors can be improved with a single axis crooked mirror positioned under the collector. In order to use a maximum of diffuse radiation, the mirror was built with a concentration factor of K=4. Thus the heat gain could be improved by a factor of 2.2. Investigations about the possibility of series production of the laboratory tested and optimized collector module have been made. The design was optimized for this purpose to minimize the costs of production while reaching a maximum of heat gain. Hereby the method of cost analysis was applied. With 20 refs., 65 figs., 14 tabs.

3271 **(BMFT-FB-T—86-193) Study of solar air heaters and of their components by means of an indoor test facility. Final report.** Leiner, W.; Altfeld, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bochum Univ. (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik). Dec 1986. 287p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750002/JAW.

An indoor test facility with a solar simulator has been constructed for testing flat solar air heaters (air collectors). The facility is able to simulate ambient conditions like solar radiation, incident angle, wind velocity, ambient air temperature and humidity and to reproduce such test conditions. Solar air heaters of different designs with regard to transparent covers, absorbers and air ducts have been realised by means of a reusable 'standard casing' and have been tested. Some commercially available collectors have been tested in comparison. In addition to the tests, the internal dimensions (height of air duct, rip distance etc.) of different types of collectors have been optimized with regard to high thermal efficiencies and low pressure losses. For this the net exergy flow to the heat transfer medium (air) was maximized. It could be shown that the results are also valid for changing operation conditions within a large range, and that the optimized air heating collectors have almost the same efficiency as water heating ones and need little auxiliar energy. With 98 refs., 11 tabs., 133 figs.

3272 **(BMFT-FB-T—86-196) Development of economic collector systems. Final report.** Hanselmann, G.; Kraft, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); M.A.N. Technologie G.m.b.H., Muenchen (Germany, F.R.)). Dec 1986. 251p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750131/JAW.

Basing on the experiences in manufacture, installation and operation with the collector-module HELIOMAN 3/32, gained in solar farmplants in Spain, Australia, Mexico and Italy, a new development was started with the aim to design a collector-module with lowest possible specific costs for the 'installed plant'. As main application was foreseen the production of industrial process heat within a temperature range of 120degC to 300degC. Technologies, that have been approved with the HELIOMAN 3/32 have been applicated also for the new developed HELIOMAN 480. With 14 refs., 10 tabs., 42 figs.

1420 Heat Storage

REFER ALSO TO CITATION(S) 3264

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

3273 **(DOE/ID/12606—T1) Geothermal resource assessment, South Dakota: Final report.** Gosnold, W.D. Jr. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Jul 1987. Contract FG07-85ID12606. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000635/JAW.

Seven geothermal aquifers in South Dakota contain an accessible resource base of about 11,207 x 10^{18} J. The potentially productive geothermal aquifers are: Deadwood Formation (Cambrian), Winnipeg Formation + Red River Formation + Englewood Limestone (Ordovician through Devonian), Madison Limestone (Mississippian), Minnelusa Formation (Mississippian-Permian), Inyan Kara Group (Cretaceous), and Newcastle Sandstone (Cretaceous). The resource estimate was obtained by first using heat flow, thermal conductivity, temperature gradient, and stratigraphic data to estimate aquifer temperatures. The heat content of each aquifer was determined from the product of the volumetric heat capacity, aquifer volume, and temperature difference between the aquifer and the mean annual temperature for a 14 x 14 grid of 240 km^2 cells. Geothermal fluid temperatures range from about 120°C in the Deadwood Formation in the Williston Basin to about 30°C for the Newcastle Sandstone in south-central South Dakota. The area containing the resource lies largely west of the Missouri River. About 10,000 km^2 of the resource area is characterized by anomalously high heat flow values greater than 100 mW m^{-2}.

3274 **(EUR—10281-FR) Experimental determination of the hydrothermal properties of the geothermal aquifer of the Dogger in the Paris basin: Final report.** (Ecole Nationale Superieure des Mines de Paris, 77 - Fontainebleau (France)). 1985. 72p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900086/JAW.

This document synthesizes the results obtained on the determination of the hydrothermal properties of the geothermal aquifer of the Dogger, in the Paris basin (France). The main emphasis was put into the determination of the natural velocity of the water in the Dogger. Two methods of measurements were used, one based on the in situ dilution of a radioactive tracer in the well with time, the other on the calculation of the velocity from the permeability and the pressure gradients measured at the bottom of the wells. A detailed thermal logging of the Dogger reservoir was also used for the interpretation of the results. This series of measurements was made initially in Fontainebleau, and then repeated on two additional wells in Cachan. They provide a coherent picture of the velocity in the aquifer.

1502 Geology And Hydrology Of Geothermal Systems

3275 **(EGG-M—16287) Effects of using a continuum representation of discrete fracture networks.** Hull, L.C.; Clemo, T.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 17p. (CONF-871024—22). NTIS, PC A02. Order Number DE87014873/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The substitution of matrix or continuum permeability for discrete fracture permeability in the simulation of complex fracture systems requires a radically different treatment of transport in the matrix. The spatial distribution of pressure is reasonably well described by inclusion of only the major fractures. Transport of tracer and heat, however, depends on a detailed knowledge of fluid velocities. Two factors are involved. First, the velocities are dependent on the active porosity of the system. Because fractures channel flow, the active porosity may be much smaller than the total porosity of the system. Secondly, the distribution of velocities is general-

ly not normally distributed precluding the use of a Gaussian dispersion model. Characterization of the active porosity and velocity distribution are necessary to quantify tracer and heat movement.

3276 **(EUR—9447-EN) Description of geothermal simulator geotherm: A finite difference model of three-dimensional, single- and two-phase heat transport in a porous medium.** (Istituto Sperimentale Modelli e Structure SpA, Bergamo (Italy)). 1985. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900078/JAW.

Characterization of multiphase geothermal reservoir behavior generally requires a three-dimensional description of the system, because of the significant effects of gravity segregation between steam and water. In this study we have developed two approaches for simulating the three-dimensional behavior of geothermal reservoirs. The more general model is based on full three-dimensional numerical approximations to the governing equations. These equations, describing the behavior of both one- and two-phase geothermal reservoirs, were derived from the balance equations for mass, momentum, and energy in porous media. This development yielded two nonlinear partial differential equations posed in terms of fluid pressure and enthalpy. Unfortunately, three-dimensional models are expensive in terms of both computer execution time and data requirements. To obtain a more economical, though less general, alternative, the three-dimensional equations were partially integrated in the vertical dimension, resulting in a quasi-three-dimensional areal model posed in terms of depth-averaged pressure and enthalpy. The vertically averaged parameters in the areal model were evaluated by assuming either depth-uniform properties or vertical equilibrium, that is, gravity segregation. The areal model included effects of an inclined variable-thickness reservoir and mass and energy leakage to confining beds.

3277 **(LA—10864-MS) Geology of the Pavana geothermal area, Departamento de Choluteca, Honduras, Central America: Field report.** Eppler, D.B.; Heiken, G.; Wohletz, K.; Flores, W.; Paredes, J.R.; Duffield, W.A. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000999/JAW.

The Pavana geothermal area is located in southern Honduras near the Gulf of Fonseca. This region is underlain by late Tertiary volcanic rocks. Within ranges near the geothermal manifestations, the rock sequences is characterized by intermediate to mafic laharic breccias and lavas overlain by silicic tuffs and lavas, which are in turn overlain by intermediate to mafic breccias, lavas, and tuffs. The nearest Quaternary volcanoes are about 40 km to the southwest, where the chain of active Central American volcanoes crosses the mouth of the Gulf of Fonseca. Structure of the Pavana area is dominated by generally northwest-trending, southwest-dipping normal faults. This structure is topographically expressed as northwest-trending escarpments that bound blocks of bedrock separated by asymmetric valleys that contain thin alluvial deposits. Thermal waters apparently issue from normal faults and are interpreted as having been heated during deep circulation along fault zones within a regional environment of elevated heat flow. Natural outflow from the main thermal area is about 3000 l/min of 60°C water. Geothermometry of the thermal waters suggests a reservoir base temperature of about 150°C.

1503 Geothermal Exploration And Exploration Technology

3278 **(EMR/MRL—87-24-TR) The microseismic monitoring system at the Camborne School of Mines, Geothermal Energy Project, Rosemanowes Quarry, Cornwall, UK.** Udd, J.E. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.). Feb 1987. 16p. (MICROLOG—87-03968). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

One of the most sophisticated microseismic monitoring systems is installed at the Camborne School of Mines Geothermal Energy Project site at Rosemanowes Quarry, Cornwall, United Kingdom. The system was installed to permit accurate mapping of the propagation of fractures induced around energy recovery wells drilled in a naturally-heated rock mass. The fractures were induced in order to create an underground reservoir of fractured rock that would serve as a heat exchanger. The efficiency of the system is dependent upon the accuracy with which the reservoir is created. This report presents an overview of the project and the details of the microseismic monitoring system. 6 figs.

3279 **(EUR—10789-EN) Deep dipolar soundings in geothermal areas of Sardinia: Logudoro and Campidano.** Marchisio, M. (Pisa Univ. (Italy). Ist. di Costruzioni Stradali e Trasporti). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900083/JAW.

Two geoelectrical surveys were carried out to get information on the deep structural arrangement of areas of geothermal interest in Sardinia. The method employed was the dipolar electrical sounding technique (DES), with fully digital data acquisition and final quantitative interpretation using horizontally stratified models. In the Logudoro area, twelve soundings were carried out: eight of them were dipolar, the others Schlumberger. The results allow one to define the deep tectonic outlines along two geoelectrical sections. In the Campidano area, six DES were made. They permit one to recognize, along a section, an evident step-like structure in the deepest layer.

3280 **(UCRL—15945) State well 2-14, Niland, California, March 30 and 31, 1986.** (Edcon, Inc., Denver, CO (USA); Lawrence Livermore National Lab., CA (USA)). Mar 1986. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000789/JAW.

On March 30 and 31, 1986, a borehole gravity survey in the State 2-14 well located in Niland, California was performed. This report describes briefly the field operations and presents the field data and processed gravity data with resultant borehole gravity meter (BHGM) densities.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 3818

1508 Geothermal Power Plants

3281 **(EPRI-AP—5146) Heber geothermal binary demonstration plant: Design, construction, and early startup: Topical report.** (Burns and McDonnell Engineering Co., Kansas City, MO (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 205p. NTIS, PC A10/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000797/JAW.

Study of the concept for a large commercial size binary-cycle geothermal demonstration plant began in 1974. It was perceived that such a project would fill the need to advance the art of binary-cycle technology to the point that it could be used on a large scale for the development of moderate temperature geothermal resources. The Plant is rated at 45 MWe (net) and is located near Heber in the Imperial Valley of California. Construction began in June 1983 and as completed in June 1985. This report presents the results of design studies and field experiments that provided the data for detailed design. It discusses the plant's final design, highlights the logic behind key design decisions, and gives project costs. It describes the planned three-year test and demonstration program. It also includes a list of reports, studies, project documents, and technical papers related to the project.

1509 Geothermal Engineering

3282 **(BNL—40177) Treated ceramic microsphere-cement lightweight composites for geothermal cementing systems.** Sugama, Toshifumi; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 16p. (CONF-871024—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014916/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The compressive strength and water permeability of high-temperature light-weight cementing materials containing sillimanite-based hollow microspheres as a filler can be improved by treating the surfaces of the microspheres with a $Ca(OH)_2$-saturated solution at temperatures up to 200°C. The precipitation of an epitaxial layer formed by an interaction between a hot calcium hydroxide solution and the surface of the sphere plays an essential role in developing favorable bonding characteristics at the interfaces and in promoting the hydration of the cement matrix. The properties of the composites include a slurry density of <1.2 g/cc at 25°C, a 300°C-24 hour compressive strength of >1015 psi (7.0 MPa), a water permeability of $<10^{-4}$ Darcy, and a bulk density of <1.0 g/cc. It was observed that tobermorite-truscottite transformation and anorthite formation during autoclave exposure for 180 days in brine at 300°C results in slight strength reductions and increased water permeability.

3283 **(LBL—23723) A multi-feedzone wellbore simulator.** Bjornsson, G.; Bodvarsson, G.S. (Lawrence Berkeley Lab., CA (USA); National Energy Authority (Iceland)). Jun 1987. Contract AC03-76SF00098. 7p. (CONF-871024—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000618/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

A multi-feedzone wellbore simulator has been developed. This computer code is quite general as it enables one to compute downhole conditions in wells with an arbitrary number of feedzones during discharge or injection. The simulator is applied to flowing pressure and temperature surveys from various wells in Mexico, Iceland and Kenya. It is demonstrated that such a model can be used to estimate flow rates and enthalpies of individual feedzones.

1520 Geothermal Data And Theory

3284 **Magnetic Rayleigh number and time dependent convection in cooling lava lakes.** Carrigan, C.R. (Geophysics Research Division, Sandia National Laboratories, Albuquerque). *Geophysical Research Letters;* **14**: No. 9, 915-918(Sep 1987).

Estimates of the Rayleigh number are necessary for determining the thermal and dynamic states of convecting magma. Calculation of a temperature based Rayleigh number, Ra/sub T/, is complicated by the thermal coupling that exists between an intrusion and its host. However, the typically greater thermal resistance of the host regime compared to that of convecting magma can allow the host to control heat flux from a magma chamber in a manner somewhat independent of the state of convection in the chamber. In a system where heat flux is controlled rather than temperature, a heat flux based Rayleigh number, Ra/sub F/, is a more natural parameter to employ, although it has not been used in most magmatic convection models. While the insulating properties of the host regime tend to reduce the value of the thermal Rayleigh number, whether temperature or flux based, this value can be very large compared to any critical value of the Rayleigh number that might exist. The quantity Ra/sub F/ is used to obtain useful relationships for estimating the thermal and kinematic regime in magma. Conservative models of a cooling lava lake, which include temperature dependent viscosity, show that convection will be vigorous enough to circulate phenocrysts. However, the time dependent nature of magmatic convection and the tendency of whole body convection to vanish before crystallization is complete severely complicate any attempt to infer convective amplitudes from the observed distribution of crystals "frozen" into the interior of the body. copyright American Geophysical Union 1987

17 WIND ENERGY

1706 Wind Energy Engineering

3285 **(ETSU-WN—5039-Pt.1) Wake interaction studies on the HWP-300/22 and WEG MS-1 wind turbine generators on Burgar Hill, Orkney.** Scott, A.M. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 112p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given of experimental studies on wake interactions and their effect on machine fatigue loadings and power output for a 300 kw and a 250 kw horizontal axis wind turbine generator. The report covers the establishment of the site data collection system, operational experiences, analysis of the site data and comparison with other data. It is concluded that the effect on blade loadings and hence rotor fatigue can be clearly identified and appear to be significant.

3286 **(ETSU-WN—5079-Pt.1) Use of glass reinforced plastics and advanced composites for wind turbine blades. A review of experience in their use and of relevant design procedures and codes.** Phillips, D.C.; McCarthy, J.; Davis, A.G.; Stott, J.E.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jun 1987. 135p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Report prepared for VAWT Ltd. .

A review is given of glass reinforced plastics and advanced composites used worldwide for wind turbines. Particular attention is paid to the practical experience with these materials as well as the relevant design procedures and codes. For comparison the design codes of statutory authorities for aircraft and flight vehicles, ships and submersibles are reviewed.

3287 **(NP—8770006) Study of a dual-fed asynchronous motor with field-oriented controls for the utilisation of electricity gained from wind energy up to 20 KW.** Suchaneck, J. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). 7 Feb 1986. 133p. (In German). NTIS (US Sales Only), PC A07. Order Number DE88770006/JAW.

The studies, which are discussed in detail, were carried out with the aim of demonstrating that wind power systems under 20 kW can still be used to work in partially wind-driven operations, providing the regulation system is appropriate. An asynchronous motor (ASM) with a slip-ring rotor was used. Its control and regulation was carried out by means of a field-oriented algorithm. The system feeds electric current into a grid at a regulated generator rev range of 650-1050 1/min, at an efficiency rate which was predominantly around 60%. The system is protected against overloading in that the rotor windings short-circuit if 1050 1/min is exceeded, and the regulated generator changes to an asynchronous generator. Exact details are given of the wind rotor, the generation of electricity from wind power, the ASM, the regulation of energy transmission, laboratory set-up (computer system, machine set, adjustment parts, measuring receptors), data collection and evaluation, and the practical results. (HWJ).

3288 **(SERI/TP—217-3223) Accurate rotor loads prediction using the FLAP [Force and Loads Analysis Program] dynamics code.** Wright, A.D.; Thresher, R.W. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1987. Contract AC02-83CH10093. 10p. (CONF-871062—5). NTIS, PC A02. Order Number DE88001109/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

Accurately predicting wind turbine blade loads and response is very important in predicting the fatigue life of wind turbines. There is a clear need in the wind turbine community for validated and user-friendly structural dynamics codes for predicting blade loads and response. At the Solar Energy Research Institute (SERI), a Force and Loads Analysis Program (FLAP) has been refined and validated and is ready for general use. Currently, FLAP is oper-

ational on an IBM-PC compatible computer and can be used to analyze both rigid- and teetering-hub configurations. The results of this paper show that FLAP can be used to accurately predict the deterministic loads for rigid-hub rotors. This paper compares analytical predictions to field test measurements for a three-bladed, upwind turbine with a rigid-hub configuration. The deterministic loads predicted by FLAP are compared with 10-min azimuth averages of blade root flapwise bending moments for different wind speeds. 6 refs., 12 figs., 3 tabs.

3289 **(TES—C697-13) Vertical axis wind turbine and wind prospecting site technical summary for 1986.** (TES Ltd., Ottawa, Ontario (Canada)). Feb 1987. 179p. (MICROLOG—87-03756). Renewable Energy Branch, Energy Mines and Resources Canada, 460 O'Connor Street, Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A considerable amount of research required to assess the viability of vertical axis wind turbines (VAWTs) in certain areas of Canada is being conducted. TES Limited was contracted to analyze data on wind speed distribution and VAWT performance from numerous wind prospecting and generating sites across Canada. It is hoped that over a period of several years of continued analysis major conclusions can be formulated regarding the technical viability of installing VAWTs in certain areas to augment future electrical generating capacity. This report summarizes the data for 1986 obtained from seven sites. 8 figs., 5 tabs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 3358, 3358

3290 **(BMFT-FB-T—86-182) Remote heat supply system from a power station in a low temperature area. Final report.** Hummelsiep, H.; Schimeczek, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Saarberg-Fernwaerme G.m.b.H., Saarbruecken (Germany, F.R.)). Dec 1986. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750004/JAW.

With the realization of the remote heat supply system in Quierschied, it was demonstrated that it is possible - at relatively low costs - to supply areas with remote heating system which were up to now considered as unsuitable. The following constituents were joined together for a systematic energy supply: Waste heat recovery, power heat coupling, single pipe remote heating system and low temperature heating technique. For this project, cool water circulation has been used as heat transfer medium which has already a temperature of about 35degC. Due to high salinity, it was necessary to pay special attention to the selection of the suitable materials. As a transport conduit fiber-concrete connecting pipe with socket joints was used, which proved to be resistant against remote heating system water. With this installation system it was possible to reduce the costs by 30% compared to a conventional transport conduit with forward and return motion. Also, the layout of the heat supply distribution, as low temperature network to the area, did contribute considerably to the economy. As the flow temperature amounts to 60degC only and the return temperature to 28degC only no costly compensation measures were necessary and the runback could be laid without heat insulation. With 26 figs.

3291 **(BMFT-FB-T—86-207) Optimization of heat extraction from power plants taking into account the time-dependent fluctuation of power and heat demand and making use of accumulators. Final report.** Beer, J.; Rukes, B.; Windorfer, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). Gesamtanlagentechnik und Systemleittechnik; Wibera Wirtschaftsberatung A.G., Duesseldorf (Germany, F.R.)). Dec 1986. 187p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750128/JAW.

The objective of this study ist to equip a hard-coal-fired intermediate-load unit to be newly constructed such that the heat demand required can be covered as economically as possible without modifying the power generation schedule specified. It is to be demonstrated, in particular, how the procurement of replacement process heat can be influenced by using heat accumulators in the event of power plant outages or standstills during the weekend. The technical and economic data were stipulated for the units to be analyzed alternatively with 200, 400 and 800 MW electric power, from which units a varying thermal output (100 to 500 MJ/s) is to be extracted. These data can be used to study the effect of different power plant equipment by means of a computer code prepared specifically for this purpose. In this context, the load requirements of the power plant in terms of district heating and power can be processed on an hour-to-hour basis. In most cases, an increase in steam generator capacity in conjunction with a heat accumulator proved to be the most favourable power plant equipment. The optimum accumulator is only 1/10 to 1/2 as large as the weekend accumulator designed for maximum heat demand. The specific heat generation cost ex works amounts to 28,00 to 37,00 DM/MWh without and 21,00 to 32,00 DM/MWh with subsidy in accordance with the '3. Verstromungsgesetz' (Third Electricity from Coal Act). With 35 refs., 99 figs., 18 tabs.

3292 **(BMFT-FB-T—86-256) Heat and power station with atmospheric fluidized bed combustor of Lueneburg-Nord, HASTRA. Final report.** Huschauer, H.; Joswig, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Deutsche Babcock A.G., Oberhausen (Germany, F.R.); Vereinigte Kesselwerke, Duesseldorf (Germany, F.R.)). Dec 1986. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750129/JAW.

Two atmospheric fluidized bed combustors for a heat and power station, including fuel preparation plant, deashing system and filter system have been tested in long-time test. The work program included test of a coal feeding system, optimization of the fluidized bed combustor and long-time behaviour of plant components and their optimization. With 11 figs., 1 tab.

3293 **(CEA-R—5373) Analysis and optimization of the thermal behaviour of a sprinkled greenhouse with underground heating: Increased value of power station waste heat - application to greenhouse cultivation energy independence.** Lemaitre, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Dec 1986. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753249/JAW.

A global thermal approach to sprinkled greenhouse cultivation was developed, which led to monographs which can be used for preliminary studies. As a second step, the thermal behaviour of this particular greenhouse was used to define the relevant parameters for the optimisation of the procedure and the ideal characteristics of the material to be used for the shelter. At the same time, a physical model of a buried tubular heat exchanger was built, together with a flexible and thoroughly tested computer program. An example of its use to help determine the dimensions for ground heating systems is presented. The various waste heat recovery procedures described have been studied, leading to an internal economic study including a comparison with other means of greenhouse heating.

3294 **(DOE/MC/21098—2248-Vol.2) Conceptual designs of advanced high-temperature desulfurization processes: Volume 2, Integrated gasification combined cycle: Final report.** Klett, M.G.; Boulay, R.B.; Buchanan, T.L.; Chen, H.T.; Fischer, W.H.; Hirschenhofer, J.H.; Losovsky, M.L.; Underkoffler, V.S. (Gilbert/Commonwealth, Inc., Reading, PA (USA)). Dec 1986. Contract AC21-84MC21098. 333p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE87001076/JAW.

Purpose of this effort is to provide conceptual commercial-scale designs, including engineering, relative cost, and economic information for high-temperature desulfurization processes. The commercial-scale processes were designed as an integral part of a nominal 100-MW(e) power plant. Two types of power plants were con-

sidered, a coal gasification molten carbonate fuel cell (MCFC) power plant and an integrated gasification combined-cycle (IGCC) power plant. Three desulfurization processes combined with three different gasification processes were evaluated, for a total of 16 cases for the MCFC power plant. The three desulfurization processes evaluated were: METC's zinc ferrite process, Battelle Pacific Northwest Laboratory's solid-supported molten salt process, and Institute of Gas Technology's mixed metal oxide process. This volume presents the results for the IGCC power plant.

3295 (DOE/MC/23166—2404) **Advanced Coal-Fueled Industrial Cogeneration Gas Turbine System: Semiannual report for the period December 2, 1986-June 1, 1987.** LeCren, R.T.; Smith, K.O. (Solar Turbines, Inc., San Diego, CA (USA)). Jun 1987. Contract AC21-86MC23166. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87006520/JAW.

Objective of the Solar/METC program is to prove the technical, economic, and environmental feasibility of a coal-fired gas turbine for cogeneration applications through tests of a Centaur Type H engine system operated on coal fuel throughout the engine design operating range. The five-year program consists of three phases: Phase I - System Description, Phase II - Component Development, and Phase III - Prototype System Verification. This report covers Phases I and II.

3296 (EPRI-CS—5320, pp 3.5-3.24) **NDE of steam piping.** Becker, F.L.; Walker, S.M. (J.A. Jones Applied Research Co., Charlotte, NC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The rupture of seam-welded hot reheat pipes at three fossil fired electricity generating stations has prompted an industry wide program of inspections. These failures along with the ever increasing number of header and steam line girth weld cracks being found, have demonstrated the need for improved nondestructive evaluation (NDE) capabilities in the fossil utility industry. This need has been recognized by the Electric Power Research Institute (EPRI) and the NDE service industry. Research, development and demonstration programs are currently underway which promise to provide reliable and cost effective methods for insuring the continued integrity of fossil fired electricity generating stations. An overview of the failures and problems, as well as the activities currently underway to provide effective NDE solutions are presented.

3297 (EPRI-CS—5320, pp 3.25-3.35) **Detroit Edison experience in the examination of hot reheat piping welds.** Collins, R.V.; Connell, D.J.; Mullens, J.R.; Schaefer, J.E. (Detroit Edison Co., MI). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

On January 30, 1986, Detroit Edison experienced a failure in the North hot reheat line of Unit 1 at Monroe Power Plant. Subsequent to the failure, Detroit Edison has examined about 2000 feet of hot reheat (HRH) piping. The many experiences gained during these operations are described.

3298 (EPRI-CS—5320, pp 3.37-3.45) **Inspection of hot reheat piping at the Omaha Public Power District.** Morris, V.G. (Omaha Public Power District, NE). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The activities of the Omaha Public Power District (OPPD) to insure the integrity of a seam-welded hot reheat steam line are described. Approximately 425 linear feet of pipe had all asbestos insulation removed and 100% of the welds were visually, ultrasonically, and magnetic particles inspected. Minor cracks were identified, repaired, and the pipe was reinsulated. The work was competitively bid to outside contractors and closely monitored to insure completion within a defined time frame and budget. In addition to application of all current NDE procedures, OPPD has demonstrated that large-scale piping inspection work can be accomplished economically.

3299 (EPRI-CS—5320, pp 3.47-3.69) **Critical piping inspection program at Utah Power & Light Company.** Hall, F.S.; Clark, M.D.; Keys, R.L.; Stasis, R.P. (Utah Power & Light Co., Salt Lake City). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Stone & Webster and Independent Testing Laboratories performed a comprehensive nondestructive examination on critical (high temperature steam) piping at three Coal-Fired Steam Electric Generating Units for Utah Power & Light Company. Piping drawings were reviewed and stress analysis was conducted to identify the locations where nondestructive examinations should be performed. The inspection work used state-of-the-art technologies and included the following: (1) analysis of installed piping to confirm specified alloy using an x-ray fluorescence alloy analysis device; (2) ultrasonic (UT) examination of 100% of longitudinal seam welds and 30% of circumferential welds using a computer-enhanced data acquisition system, augmented by manual UT to determine flaw size; (3) examination of attachment welds, weldments, and welds previously examined by UT using magnetic particle techniques; and (4) examination of the metallurgical microstructure of selected areas to determine if creep damage had occurred. Following in situ and laboratory examination, Stone & Webster performed fracture mechanics analyses to assess the significance of flaws to determine whether repair, replacement, or reinspection was required. To facilitate planning efforts Stone & Webster is preparing reports for each unit which documents the results of the examinations and provides specific recommendations for the additional work required. Careful planning and cooperation among the utility, engineer, and the contractor contributed to the successful completion of asbestos removal, inspection, repairs, and reinsulation within the scheduled four week outages.

3300 (EPRI-CS—5320, pp 3.71-3.86) **Steamline condition assessment using advanced automated ultrasonic imaging system.** Bhave, A. (Combustion Engineering, Inc., Windsor, CT). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

An ultrasonic technique has been developed and applied to the detection of flaws in fossil power plants. The technique utilizes a multitransducer system mounted on a pipe crawler device. The transducer arrangement and their distance from the weld center line is present as per the examination requirements. Data were acquired and analyzed using a computer based ultrasonic imaging system. A complete volumetric examination of the pipe weld was performed in a single pass. Results indicate that this technique can detect fabricated and service induced defects as well as, and in most instances superior to conventional ultrasonic techniques.

3301 (EPRI-CS—5320, pp 3.87-3.96) **Using BNA to screen potential inspection sites in thick-walled pressure parts.** Yavelak, J.J.; Sherlock, T.P. (Babcock & Wilcox, Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Barkhausen Noise Analysis (BNA) is a unique nondestructive measure of microscopic stresses and structure within ferromagnetic materials. If applied correctly, this inspection tool can provide valuable information regarding the high stress/soft structure areas within a pressurized component, i.e., those areas most prone to failure. Once identified, the suspect areas can be routinely examined to forewarn of catastrophic failure. Babcock and Wilcox has been investigating the use of BNA for life prediction of boiler pressure parts over the last three years. During that time, BNA data has been compared to other measures of stress and strain such as x-ray

diffraction, ultrasonics, strain gage sectioning, and real time loading in a tensile test machine. A correlation of BNA data with other measurement techniques on typical new and used boiler steels is presented. Practical field test results are also provided which demonstrate the unique capabilities of BNA for the evaluation of headers and piping systems.

3302 (EPRI-CS—5320, pp 3.97-3.110) **High-energy inspection of steam lines without removing the insulation.** Grover, J.L. (Aptech Engineering Services, Palo Alto, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Conventional nondestructive examination techniques for welds in high energy piping require that either the insulation be removed for access to the pipe O.D. or that a short section of pipe be removed to allow for internal inspection. An alternative to conventional inspection technique is presented, i.e., high energy radiography. High energy radiography employs a portable linear accelerator that has sufficient energy to penetrate through double walls of steel and insulation with relatively short exposures. The technique can be employed with the unit on-line. The results of the Electric Power Research Institute sponsored demonstration program and radiographs of service induced and laboratory prepared weld defects are presented.

3303 (EPRI-CS—5320, pp 3.111-3.122) **Residual stress measurement using NDE methods.** Ruud, C.O. (Pennsylvania State Univ., University Park). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The role of residual stresses in the failure of structural components through stress corrosion, fatigue, premature fracture, etc., is receiving increased attention. This is due to a number of factors including the desire for increased reliability of components with concurrent reduction in the amount of material in the structure. Furthermore, fracture mechanical analysis is rapidly becoming an important practical analytical method for design, and when this much more detailed approach is applied, the residual stress fields in critical structural sections must be known. In order to economically supply the residual stress information on complex structures, nondestructive methods of measurement are required. The object of this study was to review the state of the art of nondestructive residual stress measurement methods and evaluate their applications and limitations. The conclusion was that the X-ray diffraction techniques are the only reliable, truly nondestructive methods for which the technology is sufficiently developed to be broadly applicable in an industrial environment. The ultrasonic techniques hold the greatest promise for the future in that three-dimensional stresses within the volume of the components might be measured and X-ray diffraction can provide only surface measurements nondestructively.

3304 (EPRI-CS—5320, pp 3.123-3.138) **Advanced NDE for creep damage.** Singh, G.P.; Birring, A.S.; Lamping, G.A.; Scheibel, J.R. (Univ. of Texas, San Antonio). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

As a result of operation at elevated temperatures, power plant components experience creep. Changes in metallurgical structure and microscopic cracking occur after periods of operation and lead to component failure. EPRI has just initiated a 5-year program entitled Advanced NDE for Creep Damage (RP1865-7). The objective of this program is to develop NDE methods for detection and characterization of microscopic creep damage. The NDE methods that will be initially evaluated to determine their potential for detecting and characterizing such damage are described. Once the best method has been identified, development of a portable prototype creep detection and characterization system is planned for application in the power plant environment.

3305 (EPRI-CS—5320, pp 3.139-3.148) **Acoustic and acoustic emission monitoring of fossil power plant components.** Stevens, D.M.; Sherlock, T.P.; Stevenson, T.; Reynard, J.; Scheibel, J.R. (Babcock & Wilcox, Lynchburg, VA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Airborne noise monitoring methods have been used for a number of years to monitor fossil power plant components. Some of these earlier methods consisted of the plant operators walking down the boiler from top to bottom; stopping at periodic locations; and listening, by ear, to the boiler noise through observation doors. With experience, the operator could detect problems such as boiler tube leaks or malfunctioning soot blowers. Systems have now been developed which utilize this technology to detect failures in operating fossil plants. Acoustic emission monitoring, the detection of structure borne stress waves caused by localized deformation of material, is also being recognized as a viable technique for component monitoring in fossil plants. Advanced in electronics and sensor development, plus aggressive research sponsored by EPRI and others have resulted in equipment and techniques that utilize acoustic or acoustic emission technology for providing increased plant availability and/or improved performance. Examples of applications include leak monitoring in tubes, headers, steam lines, and feedwater heaters. Other applications include crack growth detection in thick wall components such as headers and steam lines. These current applications are reviewed and future applications of these technologies are discussed.

3306 (EPRI-CS—5320, pp 3.149-3.167) **Life extension program reveals the need to replace critical boiler components as soon as possible.** Adams, R.G.; Tordonato, S. (Boston Edison Co., MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Mystic Station Unit #4 boiler is a controlled circulation, vertical pendant type radiant superheater and reheater, divided furnace boiler, designed for balanced draft firing of coal or oil. Commissioned in November 1957, the boiler is rated at a maximum continuous rating of 935,000 lbs/hr at a main steam temperature and pressure of 1000°F and 1940 psig with a reheat steam flow of 842,500 lbs/hr at 455 psig and 1000°F. During the scheduled 1986 annual unit overhaul, a planned Life Extension and Condition Assessment study was performed of all boiler, turbine, high energy piping, and major auxiliary components. This study was carried out utilizing the recently established EPRI guidelines for Fossil Plant Life Extension. The Foster Wheeler Energy Corporation (FWEC) was contracted with to perform the engineering analysis and inspection guidelines for all boiler components. The findings of existing conditions, i.e., severely damaged low temperature superheater outlet header, (bowing at center line and tube ligament cracking), high temperature superheater outlet header (unknown crack cause of header Tee connections and tube ligament cracking) that require replacement as soon as practical are described. Inspection methodologies are outlined that support the findings, including video records (taped optical camera inspections). FWEC recommendations relative to the restarting of the unit and subsequent 2nd and 3rd party (Combustion Engineering and Aptech Engineering Services Inc.) inspection and recommendation criteria are also outlined.

3307 (EPRI-CS—5320, pp 3.169-3.197) **Reheat outlet header inspection methodology.** Bush, S.A.; Lefton, S.A.; Nelson, S.H. (Colorado-Ute Electric Association, Inc., Montrose, CO). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The purpose of this study was to document and suggest for others' consideration, an inspection methodology for general use with high-pressure headers. It was developed for a chrome-moly (2-1/4Cr-1Mo), seam-welded reheat outlet header on a steam gener-

ator designed by Combustion Engineering (CE). The particular header is on Colorado-Ute's Hayden Station Unit 2, jointly owned with Salt River Project, headquartered in Phoenix, Arizona. The methodology development which evolved from the header inspection project is detailed. The planning, inspection and permutations to determine header serviceability before returning the equipment to operation are delineated. Finally, the inspection data collected, evaluations made, conclusions reached, and recommends future action are presented. The intention was not to establish a methodology set in concrete but explore the many and varied considerations encountered with a project of this nature. If is realized that conditions and situations vary and these changes may dictate the eventual course of action which individual inspectors or inspections will follow.

3308 (EPRI-CS—5320, pp 1-18) **Fossil plant inspections: an EPRI perspective.** Scheibel, J.R. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Boiler, turbine, and balance-of-plant components degrade over time due to creep, fatigue, erosion, and corrosion impacting the safe, efficient, and reliable operation of aging fossil plants. Improved inspection practices, together with remaining life analysis and diagnostic monitoring, can assist in maintaining the high availability of critical plant components. Improved inspection system; based on thermography, ultrasonics, and electromagnetic techniques under development by EPRI are described. Many of these techniques have been field demonstrated and are commercially available.

3309 (EPRI-CS—5320, pp 1.5-1.8) **Role of NDE in utility maintenance strategy: technical and economic aspects.** Pond, R.B. Jr. (Baltimore Gas and Electric Co., MD). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Forced power plant outages present a major economic risk to a utility. The maintenance costs of component replacement or repair, and the increased purchased fuel and energy costs are a potential liability to most utilities. With limited and sometimes declining resources, plant and outage management become studies in bridled prudence. A key element to manage plant operation and maintenance well is the capability to mitigate, control or monitor conditions that have the potential of causing unplanned outages. Most utilities find maximizing plant availability and minimizing forced outages and related costs an engaging problem. An optimum NDE program for fossil-fueled power plants is discussed.

3310 (EPRI-CS—5320, pp 1.9-1.18) **Nondestructive examination at Virginia Power: a management perspective.** Throckmorton, E.W. (Virginia Power, Richmond). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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In 1982 the cost of NDE Services to Virginia Power was estimated to be in the area of 4 million dollars. This was a weak estimate as the costs were fragmented and often unidentifiable (ISI cost related to the nuclear program being a notable exception). The performance of NDE is often related to safety, effective maintenance, and decisions concerning the continued operation of a component. Therefore, management also was concerned with the quality of the NDE Services. Concerned not so much with the ability of the vendors, but more with the use of nondestructive testing by the plants. Especially in the fossil stations, the use of NDE Services was being controlled by whomever had a job involving NDE. These people were not versed in the capabilities and limitations of the NDE methods; and therefore, were at a disadvantage in attempting to effectively use the test methods. The vendors often were not versed in power station components; and therefore, could not provide effective assistance. The goals and accomplishments of the NDE program of Virginia Power are discussed.

3311 (EPRI-CS—5320, pp 1.19-1.24) **Nondestructive testing at Tennessee Valley Authority's fossil-fired generating plants.** Steakley, M.F.; Gomien, D.A.; Hilton, S.O. (Tennessee Valley Authority, Chattanooga). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The TVA fossil-fired generating system operates a broad spectrum of plant equipment from coal barge unloading equipment to flue gas scrubbers. There are various types of pumps, fans, compressors, and chemical treatment equipment in service. The operation and maintenance of this equipment requires that many different methods of inspection be used and may require specialized equipment. All methods of nondestructive testing, i.e., ultrasonic, dye penetrant, magnetic particle, eddy current, and radiography, as well as hardness testing, dimensional checks, metallographic replicas, etching, and visual inspections are used in the examination of plant equipment. Visual inspection are often made with the aid of fiber optics borescopes, small TV cameras, or portable field microscopes. The details of these test methods, reports, and results as related to major inspection programs are discussed.

3312 (EPRI-CS—5320, pp 1.25-1.61) **Utilities' strategies for inspecting life extended units.** Presnak, R.G.; Hindley, R.W.; Wykoff, R.W.; Reinhart, E.R. (Sargent & Lundy, Chicago, IL). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Reasons are discussed for which utilities have undertaken plant life extension programs, such as deterioration of a unit's conditions or performance as indicated by declining availability and increased heat rates. The first phase is selection of components and systems for examination and testing. The second phase consists of the examination of components, assessing their remaining life, recommending equipment or system modifications, and developing cost estimates. Emphasis is placed on the selection of components and systems not included in the utilities' normal maintenance program.

3313 (EPRI-CS—5320, pp 2.3-2.10) **Ultrasonic examinations and root cause failure analysis of fossil-fired boiler tubes.** Lamping, G.A.; Meredith, W.R. (Southwest Research Institute, San Antonio, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Boiler tube failures cause approximately 6% availability loss of large fossil-fired power generating plants. This loss can be reduced by systematic approaches using ultrasonic examination and root cause failure analysis methods. Two projects sponsored by EPRI have provided utility engineers with guidelines for performing ultrasonic examinations and with details on twenty-two types of tube failure mechanisms. A manual has been published which provides descriptions of typical locations, superficial appearances, damage mechanisms, metallurgy, microstructural changes, likely root causes, and potential corrective actions. Application of the principles in the manual is being demonstrated in an EPRI-funded project at ten electric utilities over the next two years. The demonstrations will document the benefits to be gained by following a defined methodology to report failures, to determine the root cause for failure, and to apply appropriate modifications or actions to prevent additional failures. Guidelines have been published that prescribe the activities necessary for ultrasonic examinations of boiler tubes. Eight essential elements of a boiler examination should be performed to assure that possible economic benefits are obtained. Work was supported by EPRI under RP 1890 and RP 1865. Overviews of these projects are presented.

3314 (EPRI-CS—5320, pp 2.11-2.18) **Maintenance management software for boiler tubing in fossil-fired power plants.** Hanley, J.J.; Birring, A.S.; Singh, G.P.; Schiebel, J. (Southwest Research Institute, San Antonio, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

A software package, funded under an Electric Power Research Institute program, has been developed for effectively planning inspections for wall thinning in fossil-fired boiler tubing. The software assists in minimizing costs associated with maintenance, such as inspection and repair, while the life of the boiler is maximized. It can be used to predict the time for future inspections, thereby avoiding tube failures that can result in expensive downtime. Once the inspection data are obtained, the software package can be used for data analysis. This includes displaying the thickness of tubes on a color CRT screen, identifying tubes that need replacement, predicting the remaining life of tubes, and predicting the thickness of tubes at a future time.

3315 (EPRI-CS—5320, pp 2.19-2.24) **Nondestructive oxide thickness measurement in superheater and reheater tubing.** Bonin, D.W. (Babcock & Wilcox, Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Steam-carrying superheater and reheater tubes in fossil-fired boilers operate at high levels of stress and temperature that cause failure by creep rupture. Creep is accelerated by the growth of a steam-side oxide layer which inhibits heat transfer through the tube wall, increasing the tube metal temperature. Estimation of the remaining life of these tubes requires the measurement of this internal scale which, until now, involved the physical removal and laboratory examination of specimens. To overcome the disadvantages of this method, Babcock & Wilcox designed and built an ultrasonic inspection system, called NOTIS (Nondestructive Oxide Thickness Inspection System). This portable system s capable of measuring the thickness of a tube's internal oxide without removing the tube. These oxide measurements are then entered into a computer program, along with tube design and operating data, for calculation of remaining creep life. Consequently, recommendations concerning specific areas of the superheaters can be formulated based on the plotted remaining life estimates of these tubes.

3316 (EPRI-CS—5320, pp 2.25-2.40) **Infrared for inspection of boiler tubes: an update.** Bobo, S.N. (Nondestructive Engineering Corp., Cohasset, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Since 1984, NDE Corp. has been working on the development of a practical method for inspecting the tubing in a modern steam boiler using infrared. Early work indicated that potentially the most promising use of infrared would involve a flash of steam to heat the tubes rapidly while observing them with an infrared imaging device. In 1984, this method was demonstrated in the laboratory on this boiler tube mockup with manufactured flaws. Results of this method for inspecting boiler tubes are presented.

3317 (EPRI-CS—5320, pp 2.41-2.48) **EMAT (electromagnetic acoustic transducer) device for measuring fossil plant boiler tube wall thickness.** Moles, M.D.C. (Ontario Hydro Research, Toronto). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

An in-plant data model for predicting the residual life of boiler tubing, including a sampling model is described. The in-plant approach depends heavily on wall thickness measurements. Due to the expense and difficulties in measuring corroded pipe wall thicknesses with conventional ultrasonics, the Canadian Electrical Association funded a contract to design, develop and manufacture an EMAT device. EMAT devices, or non-contact ultrasonic transducers, typically consist of a powerful magnet and an eddy current coil. Pulsing the coil in the magnetic field generates an ultrasonic pulse in the material, which then behaves in the usual manner to detect defects or measure wall thickness. One of the main advantages of EMAT devices is that they do not actually have to be in contact with the workpiece, i.e., lift-off is possible. In boiler tubes, this means that ultrasonic signals can be generated and read through oxide scale, provided it is only a few millimeters thick. One of the main disadvantages of EMAT devices is that the ultrasonic signals tend to be very weak, so extensive signal processing may be required. The performance of EMAT devices is discussed.

3318 (EPRI-CS—5320, pp 2.49-2.64) **Expert system for determining boiler-tube failure mechanisms and performing preliminary root-cause analysis.** Singh, G.P.; Bains, H.S.; Lamping, G.A. (Univ. of Texas, San Antonio). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Boiler-tube failures are the primary instigator of forced outages in fossil-fired power plants. Until the failure mechanisms and root cause of a boiler-tube failure are identified and corrected, repeated costly tube failures may be experienced. Typically such analysis is very time consuming and requires expertise in several areas such as boiler operations, maintenance, and metallurgy. An expert system ESCARTA has been developed which emulates the capabilities of a human expert in boiler-tube failure analysis. ESCARTA can be used by power plant generation and operations managers, maintenance staff, metallurgist, and other plant personnel (who are not experts in boiler-tube failure analysis) to quickly determine tube-failure mechanism, conduct preliminary root-cause analysis, and recommend corrective actions. ESCARTA conducts the analysis by asking a series of questions regarding failure location, appearance, and events to determine one of twenty-two possible failure mechanisms. ESCARTA can also be used for creating and managing a data base. Furthermore, it can be used for training power-plant personnel to ask the right questions to conduct boiler-tube failure investigations. ESCARTA is very user friendly, requiring the use of only two keys (arrows and ENTER or RETURN), and can be used on an IBM PC-XT, AT or any compatible computer with about 30 minutes of training (for people who are no familiar with personal computers). The tube failure problem, expert systems, and the ESCARTA expert system software are discussed.

3319 (EPRI-CS—5320, pp 2.65-2.75) **Expert system for diagnosing weld defects.** Hathaway, W.F.; Finn, G.A. (Stone & Webster Engineering Corp., Boston, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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Due to the availability of advanced nondestructive testing methods, the identification of weld defects has evolved into an exact science. Ultrasonic, radiograph and magnetic particle inspection techniques are some of the technologies that have provided inspectors with the necessary inspection tools to properly examine a weld and determine the types and sizes of weld defects. While the inspection methods used to scrutinize welds are continually improved, with the intention of providing a higher degree of certainty that welded construction is as defect free as possible, the frequency of occurrence of weld defects has remained unchanged. Consequently, the construction supervisor has had to become an expert at repairing defective welds. Expert systems technology and the structure of the Weld Defect Diagnostic Expert System are described in detail.

3320 (EPRI-CS—5320, pp 3.199-3.213) **Stress analysis: a vital part of critical piping inspections.** Hoffschneider, L.A.; Tynan, T.C.; Damon, J.E. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Inspections to ensure safety and longevity of critical piping systems are reviewed. Computerized stress analyses are identified as a vital and necessary part of these inspections. The use of this tool to evaluate piping on a system basis (i.e., material, supports, restraints, components, etc.), to analyze hot and cold modes of operation, and to identify high stress areas requiring metallurgical analyses is reviewed. Furthermore, the need to use these analyses in all phases of critical piping inspection programs is explained. Finally, a systematic and comprehensive phased inspection utilizing computerized stress analyses to verify and maintain piping system integrity is presented.

3321 (EPRI-CS—5320, pp 4.5-4.15) **Economic and technical justification of performing turbine/generator boresonics in-house.** Alley, C.T. (Duke Power Co., Charlotte, NC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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As utilities become involved in the life extension of turbine generator equipment, rotor boresonic inspection results are a major part of the remaining life assessment. The more detailed information that is available to a utility and the better understanding utility personnel have regarding the life analyses methods, the better equipped that utility is to make and understand life assessment predictions. One utility's approach to this problem presents its own boresonic inspection and analysis program are described. Advantages of performing in-house boresonic testing and analysis are covered in detail. In addition, the economic factors considered in developing a rotor inspection program are presented.

3322 (EPRI-CS—5320, pp 4.17-4.22) **Turbine/generator examinations using the ultrasonic data recording and processing system.** Buxbaum, S.R. (Baltimore Gas and Electric Co., MD). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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In the last two years, the Baltimore Gas and Electric Company (BG & E) has used various scanners and the Ultrasonic Data Recording and Processing System (UDRPS) to inspect a number of turbine spindle components. Blade buckets of a high pressure turbine, steeples, and dovetails, and keyways of low pressure spindles, and both turbine and generator rotor bores have been examined. These efforts have generated a complete data baseline of the inspected sections of these components, a baseline from which the development of service induced flaws can be tracked. Such data will be of value in making future run/retire decisions and may prove essential in extending the service life of these components.

3323 (EPRI-CS—5320, pp 4.23-4.33) **Ultrasonic inspection of fossil LP turbine disks.** Menning, R.H. (Wisconsin Electric Power Co., Milwaukee). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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Stress corrosion cracking (SCC) in the bore and keyway of nuclear low pressure turbine disks has been a significant concern since 1979. While keyway and bore cracking of disks in fossil low pressure rotors is less known, industry-wide experience has shown that fossil LP turbine rotors with shrunk-on disks are also susceptible to bore and keyway cracking. Therefore, periodic inspection of fossil disks should be performed. The difference in these similar applications of shrunk-on disks is apparently due to the Wilson line in the turbine fossil cycle occurring at a much lower temperature. This significantly reduces the SCC crack propagation rates in the moist regions of fossil turbines. Because of the slower crack growth rates, the period between inspections for fossil plants is normally longer than that for nuclear turbines. Wisconsin Electric's most recent experience in ultrasonically inspecting fossil shrunk-on turbine disks is described.

3324 (EPRI-CS—5320, pp 4.35-4.51) **Currently available nondestructive inspection methods for generator retaining ring.** Ammirato, F.V.; Stein, J. (J.A. Jones Applied Research Co., Charlotte, NC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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Most modern electrical generators employ a non-magnetic retaining ring at each end of the rotor to contain the end-windings of the machine. Many of the generators in service today have rings made from an 18 Mn-5 Cr, cold-expanded alloy. This alloy is well-suited for this purpose in terms of strength and fracture toughness. Unfortunately, it is also highly susceptible to stress corrosion cracking in the presence of moisture or other contaminants. Although the critical crack size is large, the stress corrosion crack growth rates can be rapid if the unit is exposed to moisture from leaks or condensation. Times as short as 1000 hours may be needed to propagate a crack to failure under these conditions. The use of fracture mechanisms techniques to predict inspection intervals is complicated by this high stress corrosion crack growth rate. Consequently, in-service examination methods are needed to detect cracks while they are very small to preclude their growth to a critical size before the next inspection cycle. Current methods for nondestructive testing of these retaining rings are discussed.

3325 (EPRI-CS—5320, pp 4.53-4.65) **Experience with in-service examination of nonmagnetic rings on generator rotors.** Kilpatrick, N.L. (Westinghouse Electric Corp., Orlando, FL). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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High-strength nonmagnetic steel rings are used on generator rotors to restrain endwindings and to serve as air-gap ventilation baffles. Most nonmagnetic rings presently in service throughout the industry are subject to stress corrosion. Failures due to stress corrosion cracking have been found on rings throughout the industry. In response to this problem, recommendations were made in 1983 for environment control and examination for corrosion damage. Results of examination of rings on a large number of units are presented. Evolution and effectiveness of examination procedures and evaluation of results are discussed. Recommendations are made for control of stress corrosion and outage planning for ring inspections.

3326 (EPRI-CS—5320, pp 4.67-4.76) **Leakage flux inspection method using magnetic sheet for radial keyway of shrink fit disk.** Goto, M.; Ohmatsu, K.; Itabashi, Y.; Hoashi, J.; Kakihara, K. (Toshiba Corp., Yokohama, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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A leakage flux inspection method using magnetic sheet has been proved to be valid to inspect a narrow gap radial type keyway of a shrink fit disk which has not been able to be inspected by previous techniques. Leakage flux inspection is considered to be applied for turbine components instead of conventional magnetic particle testing or penetrant testing because has superior characteristics to previous methods in respect of its recordability and traceability. Magnetic sheet, which is a flexible plastic sheet containing ferrite particles, can be stably magnetized by DC high voltage pulses in a moment. The data recorded on a magnetic sheet can be picked up by a hole-probe, probe scanner, gauss meter and A/D converter and stored in a computer. Defect data are reproduced as a B-scope image by computer processing such as 3-dimensional processing, differential processing or maximum value processing. Magnetic sheet inspection methods have been applied to full size stress corrosion cracking mock-up specimens, and its stable recordability and traceability has been verified.

3327 (EPRI-CS—5320, pp 4.77-4.83) **Automation of eddy current system for in-service inspection of turbine and generator rotor bores.** Czerw, G.J.; Viertl, J.R.M. (General Electric Co., Schenectady, NY). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

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The current project (EPRI-RP-1957-5) is a continuation of activities that began several years ago. Those results (EPRI-RP-1957-1) indicated that eddy current testing shows promise for in-service inspection. The current project investigates the degree to which eddy current testing can be used to replace bore magnetic particle testing. For this purpose, correlation studies between eddy current and magnetic particle tests are being undertaken on laboratory rotor sections and field test pieces of rotors. The eddy current data are to be gathered automatically by a combination of the Nortec-25L Eddyscope (to provide the analog eddy current signals) and the General Electric DATAQ System (to perform the automatic data acquisition). Some test results on a flaked laboratory rotor section are described.

3328 (EPRI-CS—5320, pp 4.85-4.100) **Examination and analysis methods for life assessment of turbogenerator rotors.** Wells, C.H.; Harris, D.O.; Johnson, D.P. (Failure Analysis Associates, Palo Alto, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The assessment of turbine and generator rotor lifetime must begin with identification of the mechanisms of fracture initiation and propagation. The purpose of this study was to provide a critical assessment of the capability of predicting rotor life, including near-term problems and solutions. The emphasis of the study was on the evaluation of defects and material properties near the rotor bore hole; however, problems of cracking of turbine rotor peripheral details are to be addressed in a future EPRI program as well as specific shortcomings of the current base of material properties and comparative performance of commercially-available bore ultrasonic examination systems.

3329 (EPRI-CS—5320, pp 4.101-4.117) **Electrochemical polarization technique to detect in-service degradation of material toughness.** Saito, K.; Kimura, K.; Muramatsu, M.; Kashiwaya, H.; Lu, Y.S.; Shoji, T.; Takahashi, H. (Toshiba Corp., Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

In order to evaluate structural integrity and also to ensure the safety of components of plants close to or beyond the end of a designed life, and further to extend their lives, it is of essential importance to characterize material degradation phenomena in a quantitative manner. There have been several methods to detect material degradation destructively and/or nondestructively. In this study, nondestructive evaluation procedure for detection of typical in-service material deterioration, temper embrittlement caused by impurity segregation and/or carbide coarsening are examined by use of electrochemical polarization (ECP) technique. Suitable selection of electrolyte depending upon the cause of temper embrittlement and kind of material can make it possible to evaluate in-service toughness degradation quantitatively in terms of such ECP parameters as maximum and minimum current density determined from the electrochemical polarization curve, and power spectrum of electrochemical noise (fractuation of corrosion potential). These parameters can be correlated to the material fracture properties such as the shift in FATT of Charpy-impact tests. For field application of this technique, a handy type ECP device was developed and has been utilized to the life assessment of aged steam turbine components.

3330 (EPRI-CS—5320, pp 4.119-4.143) **Emerging nondestructive techniques for damage assessment.** Viswanathan, R. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Accurate life estimations of high-temperature components are made difficult by the lack of specific information on the damage to the component in question and the inability to obtain mechanical property data in the critical regions. Many EPRI-sponsored projects have addressed this problem. Considerable progress has been achieved in the use of replication technique to assess high-temperature damage. Useful correlations have been developed to predict fracture toughness from easily measured properties such as chemistry, single Charpy impact energy measurements, hardness, and microstructural features. Other promising results are becoming available on the use of miniature samples for creep damage and toughness measurements. Nondestructive measurements such as X-ray line broadening and hardness measurement techniques are becoming available which show promise for detecting fatigue damage. These emerging techniques are described and some of the correlations developed are presented.

3331 (EPRI-CS—5320, pp 5.3-5.17) **Steam turbine blade life assessment and improvement.** McCloskey, T. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Blade failures are the leading cause of steam turbine unavailability for large fossil fuel plants in the US, costing utilities more than $235 million annually. They are also a major cause of the general decline in availability experienced by large units during recent decades. More recently, changes in operating mode have further increased the problems of many large units. The predominant causes of low-pressure blade failure are three separate parameters that can act either individually or in combination: operating environment, susceptible material, and stress (especially fatigue stress). A recent EPRI survey of 494 units indicated that unless the root cause of a failure is identified and corrected, it is likely that the problem will recur in the same group of blades. A survey showed that blade repair and power replacement costs accounted for utility revenue losses of more than $1.4 billion between 1970 and 1981. Although forced outage rates during this period declined overall, scheduled or maintenance outages increased, indicating utilities' greater attenuation to periodic turbine blade inspection. EPRI R & D on low-pressure blading concentrates on three areas: identifying the major contributors to blade failure, developing alternative technologies to improve blade reliability and extend operating life, and demonstrating developments in host utility plants.

3332 (EPRI-CS—5320, pp 5.19-5.26) **Remote eddy current inspection of turbine blades.** Willaman, D.O.; Metala, M.J.; Dailey, G.F. (Westinghouse Electrical Corp., Broomall, PA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

During the past year, the Westinghouse Power Generation Service Division has developed and qualified a remote eddy current (EC) inspection system to examine side entry blades without turbine disassembly. This system provides for rapid assessment of blade integrity during a brief unit shutdown and in highly confined spaces. The system has performed successfully during recent field trials at major utility sites and is capable of detecting shallow, service-induced cracks in both the airfoil trailing edge and in the blade root. This paper summarizes the results from those fields trials and how eddy current signals generated from cracks can be distinguished from blade geometry variations such as gouges, pitting and edge effects by using phase discrimination techniques. Although initial applications have been limited to remote inspections of certain specific blade styles, future applications could include any row of

rotating turbine blades where adequate physical access can be provided.

3333 (EPRI-CS—5320, pp 5.27-5.42) **Remote inspection of steam turbine blades.** Porter, J.P.; Reinhart, E.R.; Lenhart, J. (Reinhart & Associates, Inc., Austin, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

During the past five years Reinhart & Associates, Inc. has been involved in remote examination of L-0 and L-1 steam turbine blade rows of in-place LP turbines using visual and eddy current techniques. These tests have concentrated on the trailing edge and blade-to-rotor attachment (Christmas tree) areas. These remote nondestructive examinations were performed through hand access ports of the inner shell. Since the remote scanning system was in a prototype configuration, the inspection was highly operator-dependent. Refinement of the scanning equipment would considerably improve the efficiency of the test; however, the feasibility of remote in-place inspection of turbine blades was established. To further, improve this technology, and to provide for remote inspection of other areas of the blade and additional turbine designs, EPRI is funding a one-year project with REINHART & ASSOCIATES, INC. This project will develop a new system that employs state-of-the-art multifrequency eddy current techniques, a miniature charged coupled device (CCD) television camera and remote positioning equipment. Project results from the first six months are presented.

3334 (EPRI-CS—5320, pp 5.43-5.49) **Detection and sizing of cracks in turbine disks.** Birring, A.S.; Cervantes, R.A. (Southwest Research Institute, San Antonio, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

A major reason for reduced turbine-disk life is cracking at the steeples. These cracks can be detected nondestructively, but detection is not sufficient to decide whether to retire the disk or to continue operation. Accurate decisions in retirement can be made if an accurate crack size is known that can be used in calculating the remaining life of the disk. At present, however, no method is available for measuring crack size. Ultrasonic methods that can be used for both detecting and sizing steeple cracks are discussed.

3335 (EPRI-CS—5320, pp 5.51-5.69) **Flexible eddy-current coil arrays.** Krampfner, Y.; Johnson, D.P. (Failure Analysis Associates, Palo Alto, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

A novel approach was devised to overcome certain limitations of conventional eddy-current testing. The typical single-element hand-wound probe was replaced with a two dimensional array of spirally wound probe elements deposited on a thin, flexible polyimide substrate. This provides full and reliable coverage of the test area and eliminates the need for scanning. The flexible substrate construction of the array allows the probes to conform to irregular part geometries such as turbine blades and tubing, thereby eliminate the need for specialized probes for each geometry. Additionally, the batch manufacturing process of the array can yield highly uniform and reproducible coil geometries. The array is driven by a portable computer-based eddy current instrument, smartEDDY, capable of two frequency operation, and offers a great deal of versatility and flexibility due to its software-based architecture. The array is coupled to the instrument via an 80 switch multiplexer which can be configured to address up to 1600 probes. The individual array elements may be addressed in any desired sequence as defined by the software.

3336 (EPRI-CS—5320, pp 6.5-6.18) **Condition monitoring of power plant heat exchangers.** Bell, R.J. (Heat Exchanger Systems, Inc., Boston, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Timely identification of the limiting factors is of great value in maintaining high plant availability and low heat rates. Condensers and feedwater heaters can be significant limiting factors; their downtime can lead to forced outages, load reductions, or increased heat rates making them a prime concern. As heat exchanger tubes age, their failure rate usually becomes exponential in nature. When a given heat exchanger is allowed to reach the steep portion of the exponential curve, excessive forced outage time is the consequential result. Experience has shown, for example, that failure rates can become so excessive that entire strings of feedwater heaters must be valved out-of-service for months until a replacement feedwater can be installed. It is, therefore, imperative that probable entry into the steep portion of the failure rate curve be predicted well in advance so that early corrective action may be taken to prevent this from occurring. One of the primary reasons for inspecting power plant heat exchangers is the determination of their condition. Methods for monitoring the condition of heat exchangers are discussed.

3337 (EPRI-CS—5320, pp 6.19-6.35) **Materials engineer's role in monitoring condenser tube material performance.** Christofferson, S.W.; Conley, E.F. (Potomac Electric Power Co., Washington, DC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Systematic condenser tube monitoring programs can be devised to provide invaluable material performance information. Selection of the methods to be implemented in any given monitoring program consists of specifying the customary leak testing, eddy current testing, and other methods. However, many other commercially available monitoring methods cannot be justifiably selected on a standardized or prescribed basis. Initially, one must determine what kinds of information are required and then subsequently proceed with developing an adequate monitoring program that will fulfill the perceived needs. Typically, the content and output of monitoring programs evolve over time as cognizant engineers develop a better assessment of the problem(s). Accordingly, a monitoring program is described that is designed to be flexible and dynamic; its output provides the basic information sought, and the program also has the feedback capability to define what tests can be deleted as well as what new parameters require measurement.

3338 (EPRI-CS—5320, pp 6.37-6.45) **Finding condenser air inleakage: an introduction.** Walter, R.O. (Ohio Edison Co., Akron). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Armed with the motivation to reduce condenser air inleakage, the utilities must then face the question of how. One approach is to hire a leak detection consultant. In general, these consultants have a good reputation for locating leaks and significantly reducing the air inleakage. The limitation to using consultants are that they are relatively expensive, require mobilization time, and on initial visits are not familiar with the plant and systems layout. Maintaining air inleakage at a minimum can require ongoing effort, and for this reason as well as the above limitations with consultants, many utilities are establishing their own programs for controlling air inleakage. Methods for detecting air in leakage are discussed.

3339 (EPRI-CS—5320, pp 6.47-6.49) **Remote visual inspection service saves down-time and money.** Pellegrino, B.A. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

The capabilities of remote visual testing equipment have improved dramatically in recent years. These changes include improvements in the following four major areas of instrument design and manufacture: smaller instrument diameters allow access into very small tubes and tighter spaces; longer instrument length permits remote viewing at greater distances; improved image resolution facilitates easier interpretation of test data; and increased radiation resistance of optical and electronic components allows direct viewing in high radiation areas such as nuclear power plant components. These technological improvements have vastly increased the number of visual testing applications and have also enhanced the quality and accuracy of test information. Remote viewing instruments such as borescopes, fiberscopes, and miniature CCTV cameras are commercially available in an almost infinite variety of shapes, sizes, viewing directions and formats; each device being better suited for a particular type of remote visual examination. The only limitation to capability is the amount of capital the user wants to invest in owning such an array of specialized tools. Remote visual inspection methods are described.

3340 (EPRI-CS—5320, pp 6.51-6.66) **Magnetic flux leakage inspection of ferrous tubes in condenser and feedwater heater.** Bergander, M.J. (Scientific Technologies, Inc., Madison, CT). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

In recent years, special ferritic stainless steels, such as AL29-4CTM, Sea-CureTM, E-BriteTM, 439 and similar alloys have been introduced as a tube material in condensers, feedwater heaters, moisture separator/reheaters, and other heat exchangers. In addition, carbon steel tubes are widely used in feedwater heaters and heat exchangers in chemical plants. The main problem with the in-service inspection of these ferritic alloys and carbon steel tubes lies in their highly ferromagnetic properties. These properties severely limit the application of the standard eddy current technique. The effort was undertaken under EPRI sponsorship to develop a reliable technique for in-service inspection of ferromagnetic tubes. The new method combines the measurement of magnetic flux leakage generated around the defects with measurement of total flux in the tube wall. The heart of the inspection system is a special ID probe which magnetizes the tube and generates signals for any tube defect. A permanent record of inspection is provided with a strip-chart or magnetic tape recorder. The laboratory and field evaluation of this new system demonstrated its very good sensitivity to small defects, its reliability and ruggedness. Defects as small as 10% external wall loss in heavy wall carbon steel tube were detected. Tubes in the power plant were inspected at a rate of 300-500 tubes per 8 hrs. shift. The other advantages of this newly developed technique are its simplicity, low cost of instrumentation, easy data interpretation and full portability.

3341 (EPRI-CS—5320, pp 6.67-6.82) **Qualification method for non-destructive examination of carbon steel tubes in feedwater heaters.** Rajter, L.C.; Respet, C.B.; Hibbard, J.L. (Pennsylvania Electric Co., Johnstown). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Pennsylvania Electric Company (Penelec) operates six supercritical coal-fired units at the Keystone, Conemaugh, and Homer City Stations. There are a total of 40 high pressure feedwater heaters with carbon steel tubes at these units. Dimensions for the tubes are 3/4" outside diameter and a nominal wall thickness of 0.115". Non-destructive examination of carbon steel tubes in feedwater heaters is currently in a developmental stage. Some techniques are available; however, there are limitations on the ability to locate, size, and type defects in thick-wall carbon steel tubing. To determine if a test technique could be used in the Penelec stations, Penelec established a qualifying procedure. This procedure is described. The qualification method was applied to a test technique known as magnetic domain analysis. In addition, testing with the mock-up was used with a second technique, magnetic flux leakage. The results of applying the qualification method to these two test techniques are described.

3342 (EPRI-CS—5320, pp 6.83-6.102) **NDT methods for DA tank inspection.** Reinhart, E.R.; Roma, F.P. (Reinhart & Associates, Inc., Austin, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Due to failures in deaerator and water storage tanks, utilities, paper mills, and other industrial plants are presently inspecting these tanks using nondestructive testing (NDT) methods. With proper surface preparation, the wet fluorescent magnetic particle test (WFMT) is a highly sensitive NDT method of detecting the fine transverse and longitudinal (to the weld center line) cracks in and near the weld areas on the inside of deaerator and water storage tanks. The ultrasonic NDT method is also useful for determining the remaining wall thickness of the tanks in situations where surface erosion is present. These NDT methods are also used to verify the integrity of repairs on the vessels (grinding, welding, etc.). Other NDT methods are also used for surface and volumetric inspection. While use of these NDT methods is not difficult, analysis of results requires experienced and qualified inspectors, preferably with directly applicable deaerator inspection experience. Until a generic solution is found to alleviate the rash of cracking problems found in the deaerator vessels, inspections using NDT methods remain one of the most effective methods of preventive maintenance. Details of the various NDT inspection methods are covered in this paper, including test results from evaluation of test plates removed from a retired storage vessel. These tests are part of an industry cooperative effort, coordinated by the National Association of Corrosion Engineers (NACE).

3343 (EPRI-CS—5320, pp 6.103-6.115) **Computerized tube tracking improves power plant availability and performance.** Swancer, S.; Burns, R.; Dykes, J.; Martinsen, D.; Svansjo, M.; Murdock, D.; Flander, R.; Holhut, W.; Stellburg, V. (Burns & Associates Engineers, Martinez, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920569/JAW. (CONF-8609330—).

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Tube failures are the leading cause of forced outages in electric power plants. Good record keeping on failure locations and causes is important in the minimization of this problem. However, manual systems for record keeping are often too bulky to support timely and effective use of information. Computers offer a solution, because of their unique capability to manage data and perform calculations. The BAE software package called TubeTrack is an application which enables power plant personnel to take advantage of the latest computer technology in the tracking of tube failures. This method of tracking tube failures is discussed.

3344 **(ERCB/C—870521) Small power inquiry. Proceeding No. 870621. Planning meeting.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 21 May 1987. 12p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

In April 1987, the Lieutenant Governor in Council requested that the Public Utilities Board and the Energy Resources Conservation Board inquire into electrical generation by small power generators and report back necessary or advisable recommendations. To plan for the inquiry the two Boards held a meeting to obtain comments and views of interested parties regarding the appropriateness of a public hearing, its location, timing, and procedures, and the need for a pre-hearing conference. The suggestions and decisions are outlined.

3345 **(ERCB/C—870610) Small power inquiry. Proceeding No. 870621. Pre-hearing conference.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 19 Jun 1987. 5p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

In April 1987, the Lieutenant Governor in Council requested that the Public Utilities Board and the Energy Resources Conservation Board inquire into electric generation by small power genera-

tors and report back to the government with necessary or advisable recommendations. In May, the Boards issued a decision that summarized their views and decisions and provided a schedule for the inquiry. The schedule is a part of this proceeding. A pre-hearing conference was held in June 1987. Administration matters and duty definition were discussed and described in this proceeding.

3346 (NEI-FI—1, pp 3.1.1-3.1.13) **Reliability analysis of the control system of a conventional power plant.** Toola, A.; Niemelae, I. (Imatran Voima Oy, Helsinki Finland; Valtion Teknillinen Tutkimuskeskus, Espoo Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper deals with a reliability study of the control system of a conventional power plant. The study is based on a reliability model of the control system. The structure of the model, the ways of utilizing it and the experience gained are discussed.

3347 (NEI-FI—1, pp 5.1.1-5.1.15) **Life cycle cost procurement of circuit-breakers.** Rise, J.L.; Larsson, P. (AB Teleplan, Solna Sweden; Vattenfall, Vaellingby, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

The paper presents an LCC-approach to the procurement of circuit-breakers for the Swedish State Power Board (Vattenfall). The approach involves a systematical evaluation of all the relevant aspects of a purchasing decision expressable in monetary terms, the so-called Life Cycle Cost (LCC). LCC thus includes the total accumulated cost of operation, maintenance and disturbance over the lifetime in addition to the initial investment cost. The purpose of and procedures for this rather simple form of LCC-procurement of a standard product is presented. The circuit-breaker is a relatively complex electromechanical apparatus for which operation and maintenance costs represent a significant part of the Life Cycle Cost. Malfunction of a circuit-breaker may have serious consequences. An evaluation model is suggested and results from a procurement case exemplifies the approach. The example is taken from one of seven batches of circuit-breakers, which so far have been purchased using the LCC-model. Since 1983, Vattenfall has procured more than 50 breakers with LCC-techniques, representing a total investment of around 5 million US dollars. Finally, some experiences from using the LCC-procurement approach are presented, and possibilities of further development are identified.

3348 (PB—87-223475/XAB) **Brown coal/oil mixtures as a fuel for diesel engines: an economic analysis. Technical report.** Bandopadhayay, P.C.; Downie, R.J.; Kowalczewski, J.J. (Commonwealth Scientific and Industrial Research Organization, Highett (Australia). Div. of Energy Technology). 1986. 38p. NTIS, PC E04/MF E04.

The viability of using Victorian brown coal as a fuel extender in coal/oil mixture (COM) fuels is investigated for large, slow-speed, stationary diesel-engine applications. The investigation examines the economic implications of converting existing diesel engines for operation on coal/oil mixtures. Previously reported experimental thermodynamic performance data for a diesel engine operating on coal/oil mixtures were used in the analysis. Engine brake thermal efficiency ratio is shown to be an important parameter in determining the economic viability of a new fuel. The simple economic analysis technique proposed in the paper can also be applied to other fuel formulations and fuel extenders.

3349 (PB—87-223517/XAB) **Archived NUMEL dataset for Hinkley Point 'B' (hp boiler and reheater).** Rowe, D. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1986. 30p. (TPRD/M—1579/R86). NTIS, PC E05/MF E05.

The report contains a set of best-estimate data representing the high-pressure boilers and reheaters on the Hinkley Point 'B' power station. It was assembled by SWR-SSD and archived by MEL. It is stored in a secure machine-readable form and can be read in automatically at the start of the steam-generator modeling program NUMEL.

3350 (PB—87-224002/XAB) **NUMEL reference dataset for the MEL Boiler Dynamics Rig.** McCabe, E.M. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1986. 69p. (TPRD/M—1553/R86). NTIS, PC E06/MF E06.

The NUMEL suite of programs are the UK reference 1D codes for thermal-hydraulic assessment of the steady-state, static and dynamic stability, and transient responses of steam generators. A large part of NUMEL validation was carried out by comparing the code predictions with the experimental rig data obtained from the Boiler Dynamics Rig (BDR) at MEL. As part of the on-going Quality Assurance (QA) support for NUMEL several series of benchmark tests are underway on the rig, involving the provision of detailed documented records for code validation. The document presents the Reference Dataset for NUMEL dedicated to providing a quantitative representation of the three steam generating tubes that form the BDR test section. Contained in the document are details of the derivation of the dataset from design drawings and specifications of correlation equations incorporated in the NUMEL dataset for heat transfer, dryout, friction factor, two-phase slip ratio and physical properties. The document details Version 1 of the Reference Dataset.

3351 (PB—87-225512/XAB) **Toshiba Review, Vol. 42, No. 6, 1987.** (Toshibe Corp., Tokyo (Japan). Principal Office). 1987. 76p. (In Japanese). NTIS, PC E04/MF A01.

See also PB—87-225520, PB—87-225538, and PB—87-199824.

This special issue on combined-cycle power generation with special features on: Preface to special issue on combined-cycle power generation; 1300°C combined-cycle power plant; Gas-turbine development; High-temperature advanced gas turbine; Heat-recovery steam generator; Low-level NOx techniques; Gas-turbine digital-control system; Steam turbine for combined-cycle use; and other general features.

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REFER ALSO TO CITATION(S) 2803, 2804, 2806, 4433

3352 (LIS—71) **List of additional technical demands on the safety of plants for storage of pressurized liquid ammonia.** Wefers, H.; Katzer, H. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)). Mar 1987. 51p. (In German). NTIS (US Sales Only), PC A04. Order Number DE88750007/JAW.

For operation of DeNO/sub x/-units in power plants it is necessary to store ammonia on the area of the power plants. The report describes technical demands of safety at plants for storage of pressurized liquid ammonia. These demands consist of progressive processes, installations and methods of operation, which seem necessary to prevent major accidents or to limit the effects of major accidents. General rules of technical science are not described once more.

3353 (OH/CR—86/362/K) **Effect of trunk injection of the growth regulators EL-500 and PP 333 on sprout growth and the increase in height of trimmed silver maple trees.** Arron, G.P. (Ontario Hydro, Toronto (Canada). Chemical Research Dept.). 20 Jan 1987. 19p. (MICROLOG—87-04171). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The control of tree growth under both transmission and distribution lines is a major expense for all electric utilities. Mechanical trimming of trees under distribution lines is routinely carried out by Ontario Hydro at intervals of six to eight years in most locations, and every four years at a few specific locations. The length of the particular trimming cycle depends on the rate of growth of the tree species involved and the amount of line clearance required. The extension of such trimming cycles by one or more years would result in a substantial cost saving. A new group of growth regula-

tors has been introduced that is effective in reducing the growth of trees without producing noticeable injury. Included in this group are EL-500: α-(1-methylethyl)-α-[4-(trifluoromethoxy) phenyl]-5-pyrimidene-methanol and PP 333: (2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl) pentan-3-ol. These have been reported to control excessive sprout growth in a number of species. In this report the effects of trunk injection in overall height of silver maple (Acer saccharinum) trees are presented. 5 figs.

3354 **(SNC—8212) Development design and construction of a computer design model program of venturi gas scrubbers employing molten salt. Report of phase 1.** (Surveyer, Nenniger and Chenevert, Inc., Montreal, Quebec (Canada)). Dec 1982. 120p. (MICROLOG—85-0545). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A program to optimize the design model was prepared including the most significant design variables. Based on this program, a hot gas scrubbing system has been designed around the optimized venturi design obtained by utilizing the computer model. The study has established that molten salt may be employed to scrub hot dirty gases with considerable saving in energy. A comparative cost estimate of the hot scrubbing system with conventional cold system has been carried out, and has shown that the hot gas scrubbing system is more economical. 6 figs., 10 tabs.

3355 **Development of the confined zone dispersion process for desulfurization of flue gas.** Zaczek, S.; Blake, J.H.; Davidson, M.J.; Pennline, H.W. (Bechtel National, Inc.). pp 253-264 of Coal technology '86: Book I. Houston, TX; Coal Technology (1987). (CONF-861129—).

From Coal Technology '86: international coal utilization conference and exhibition; Pittsburgh, PA, USA (18 Nov 1986).

In an effort to develop, a less costly way to retrofit FGD systems onto existing utility boilers, Bechtel, with assistance from DOE, is developing a process that uses existing ductwork as a spray dryer. The confined zone dispersion (CZD) process removes SO/sub 2/ from flue gas by spraying a finely atomized slurry of pressure hydrated dolomitic lime into the ductwork downstream from the air heater. This highly reactive lime slurry dispersed into the gas stream with pneumatic atomizers reacts with part of the SO/sub 2/ and dries within about 1 second. Thus, the SO/sub 2/ can be captured in a normal run of ductwork without the need for an expensive vessel, and without allowing wet solids to impact on the walls of the duct. DOE is supporting proof-of-concept tests in a pilot scale facility that treats flue gas from Unit I of Consumers Power Company's J.H. Campbell Station. The paper describes the test facility, preliminary test results, and plans for full scale demonstrations. Plans for large scale demonstrations are being implemented with two utilities. A full scale demonstration is the final step in the development before the process is commercially viable.

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REFER ALSO TO CITATION(S) 2812, 3353, 4067

3356 **(BMFT-FB-T—86-223) Joint research and development investigations of the Socialist Republic of Romania and the Federal Republic of Germany on the field of generation and transmission of eletrical energy. Final report.** Mihaileanu, C.; Edwin, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Elektrische Anlagen und Energiewirtschaft). Dec 1986. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750003/JAW.

Subjects of the joint research and development investigations of the Socialist Republic of Romania and the Federal Republic of Germany were network equivalents for contingency analysis, optimal power flow and reliability calculations. Common aim was the mutual information exchange about the models and methods developed and used in both countries. Different mathematical approaches were compared with regard to their capabilities and limits. The main field of the joint investigations were network equivalents for contingency analysis. In Romania Dimo-REI-equivalents are used for this purpose. In the Federal Republic of Germany Ward-equivalents were employed. These two different network equivalents were compared by extensive calculations of realistic networks. Starting point of comparison was a commonly settled uniform data base. Criterion of comparison was the calculation accuracy. The investigations pointed out that both Dimo-REI-equivalents and Ward-equivalents are sufficiently accurate. Concerning optimal load flow and reliability evaluations mathematical approaches, calculation problems, questions of practical use and questions already solved were discussed. The knowledge exchanged and newly obtained by the cooperation helps to improve the operation reliability and to increase the economic efficiency of electric energy supply in both countries involved. With 12 refs., 2 figs.

3357 **(BMFT-FB-T—86-248) Examination of the electrical phenomena in single phase faults occurring in coal mine power systems. Final report.** Handschin, E.; Gacka, M.; Maiweg, H.; Woltemate, R.; Ebbinghaus, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Dortmund Univ. (Germany, F.R.). Lehrstuhl fuer Elektrische Energieversorgung). Dec 1986. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750135/JAW.

This report on the selective detection of single phase faults in power systems in German collieries introduces a summary of the mathematical foundations as well as the results of background simulation programs. For the practical and secure testing of existing and new protection devices under a variety of working conditions a large model has been constructed and built. Especially the detailed examination of the selective protection against single phase faults in parallel cables led to the evaluation of a new protective principle based on the transverse difference of the zero currents. Furthermore, a configuration program is introduced, which after recording the data from the power system chooses and positions the protective devices and computes the set values. With 64 refs., 72 figs., 17 tabs.

3358 **(EPRI-EL—5279) Economics of PPP-insulated pipe-type cable: Final report.** Ernst, A. (Underground Systems, Armonk, NY (USA)). Oct 1987. 264p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920064/JAW.

This study has been designed to establish the economic range of application and the potential cost advantage of PPP-insulated pipe-type cable compared with presently utilized paper-insulated designs. The study is in two parts. In the first part the electrical and thermal characteristics of a range of cable sizes are tabulated. This data can be utilized for planning and economic comparison purposes. In the second part 12 transmission load scenarios are studied to determine the relative cost of various designs considering materials, installation and the losses over a wide range of assumptions.

3359 **(ERCB/C—870623) Alberta Power Limited. 240-kV transmission line re-route. Star area.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 23 Jun 1987. 5p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

Alberta Power Limited applied for approval to relocate a 2.4 km portion of previously approved 240-kV double-circuit transmission line. The application was considered at a public hearing in June 1987. The Energy Resources Conservation Board was willing to approve the modified application with the understanding that affected landowners would be informed and agree to the application. The transmission line re-route would be in accordance with previously agreed application and modifications.

3360 **(NBSIR—87-3643) Research for electric energy systems: An annual report.** Hebner, R.E. (ed.). (National Bureau of Standards, Washington, DC (USA). Electrosystems Div.). Sep 1987. Contract AI01-87CE34011. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001733/JAW.

This report documents the technical progress in the five investigations which make up the project "Support of Research

Projects for Electrical Energy Systems." To support the measurement of ions in the vicinity of dc transmission lines and in biological exposure facilities designed to simulate the line environment, techniques to measure ion mobility were evaluated. In addition, techniques were developed which biological researchers could use to determine the sensitivity of an AM radio to detect partial discharges in a biological exposure facility. Within the project to develop measurement techniques and obtain basic data for gaseous dielectrics, a theoretical method was developed to evaluate the consistency among electron collision, transport, and dielectric strength data for binary gas mixtures. In addition, the gas phase hydrolysis rates for SOF_2 and SOF_4 at room temperature were measured; the corona discharge oxidation mechanisms were identified using prepared samples containing $^{16}O_2$ and $H_2{}^{18}O$ or $^{18}O_2$ and $H_2{}^{16}O$; and the role of SF_6 negative ions on the SOF_4 yield was also determined. Progress in the measurement of the electrical behavior at a liquid-solid interface included the optical measurement of the dynamic electric field distribution as a streamer initiates. Progress in developing measurements for nanosecond dielectrics was made in characterization of the sources of error in the measurement of voltage pulses using E-dot probes, and the identification of the reduction of breakdown voltage in oil as the characteristic time of the voltage pulse is reduced. 78 refs., 33 figs., 2 tabs.

3361 (OH/R—86/356/K) Electromagnetic interference (EMI) investigation - Ottawa area. Goldthorpe, D.R. (Ontario Hydro, Toronto (Canada). Research Div.). 16 Feb 1987. 6p. (MICROLOG—87-04871). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Two EMI customer complaints were investigated in the Ottawa area. The major EMI sources were identified as interference from a steel transmission angle tower and a twin wood pole line. Corrective maintenance was recommended. A listing of the instrumentation used for the investigation is included.

3362 (OH/R—86/363/K) Evaluation of TVI equipment. Hatanaka, G.K. (Ontario Hydro, Toronto (Canada). Research Div.). 3 Feb 1987. 15p. (MICROLOG—87-04872). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As of April 1987, the Department of Communication no longer locates power line television interference noise sources. Ontario Hydro will assume responsibility, thus requiring suitable instrumentation.

3363 (OH/R—87/13/K) Surface attachment methods for residential service masts. Young, D.J. (Ontario Hydro, Toronto (Canada). Research Div.). 6 Feb 1987. 16p. (MICROLOG—87-04870). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Residential service masts are sometimes fastened to outside walls of buildings with straps and anchor-screws when access to interior structural members is difficult enough to discourage the use of through-bolts and u-bolts. Care must then be taken during installation to ensure that the strength of the mast fasteninga is enough to resist strains imposed by overhead service conductors. This report suggests fastening methods suitable for different types of wall construction and warns of situations where certain fastening methods may be unsuitable.

21 NUCLEAR POWER PLANTS

3364 (NUREG—0020-Vol.11-No.7) Licensed operating reactors: Status summary report, Data as of June 30, 1987. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Jul 1987. 500p. NTIS, PC A21/MF A01 - GPO. Order Number DE88900099/JAW.

The Operating Units Status Report - Licensed Operating Reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 3384, 3385, 3386, 3394, 3466, 3478, 3479, 3481, 3508, 3509, 3512, 3513, 3517, 3695, 3816

3365 (EPRI-NP—5485) Effects of ultrasonic equipment variations on crack length measurements: Final report. MacDonald, D.E.; Walker, S.M. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Oct 1987. 57p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920059/JAW.

This report was generated to assist utilities in their inspection programs when repetitive ultrasonic examination are performed on welds or components. Data are presented to document the effects of equipment and procedure variations on measured crack length, and the need for consistency when subsequent examinations are performed to detect flaw growth is explained. 7 refs., 7 figs., 2 tabs.

3366 (IKE—6-171) Model for steady-state and transient determination of subcooled boiling for calculations coupling a thermohydraulic and a neutron physics calculation program for reactor core calculation. Mueller, R.G. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Jun 1987. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750437/JAW.

VAX 11/780.

Due to the strong influence of vapour bubbles on the nuclear chain reaction, an exact calculation of neutron physics and thermal hydraulics in light water reactors requires consideration of subcooled boiling. To this purpose, in the present study a dynamic model is derived from the time-dependent conservation equations. It contains new methods for the time-dependent determination of evaporation and condensation heat flow and for the heat transfer coefficient in subcooled boiling. Furthermore, it enables the complete two-phase flow region to be treated in a consistent manner. The calculation model was verified using measured data of experiments covering a wide range of thermodynamic boundary conditions. In all cases very good agreement was reached. The results from the coupling of the new calculation model with a neutron kinetics program proved its suitability for the steady-state and transient calculation of reactor cores.

3367 (INIS-mf—10965) Monte Carlo method for shielding calculations analysis by MORSE code of a streaming case in the CAORSO BWR power reactor shielding (Italy). Zitouni, Y. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Apr 1987. 245p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700035/JAW.

In the field of shielding, the requirement of radiation transport calculations in severe conditions, characterized by irreducible three-dimensional geometries has increased the use of the Monte Carlo method. The latter has proved to be the only rigorous and appropriate calculational method in such conditions. However, further efforts at optimization are still necessary to render the technique practically efficient, despite recent improvements in the Monte Carlo codes, the progress made in the field of computers and the availability of accurate nuclear data. Moreover, the personal experience acquired in the field and the control of sophisticated calculation procedures are of the utmost importance. The aim of the work which has been carried out is the gathering of all the necessary elements and features that would lead to an efficient utilization of the Monte Carlo method used in connection with shielding problems. The study of the general aspects of the method and the exploitation techniques of the MORSE code, which has proved to be one of the most comprehensive of the Monte Carlo codes, lead to a successful analysis of an actual case. In fact, the severe conditions and difficulties met have been overcome using such a stochastic simulation code. Finally, a critical comparison between calculated and high-accuracy experimental results has allowed the final confirmation of the methodology used by us.

3368 (IWGRRPC—85, pp 10) **National programme: Argentina.** Mondino, M. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina. Dept. de Materiales de la Gerencia de Desarrollo). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3369 (IWGRRPC—85, pp 11) **National programme: Belgium.** Berthe, J. (Compagnie Generale d'Entreprises Electriques et Industrielles, S.A., ELECTROBEL, Brussels, Belgium). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3370 (IWGRRPC—85, pp 18) **National programme: United Kingdom.** Watkins, B. (UKAEA, Risley Engineering and Materials Lab.). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3371 (IWGRRPC—85, pp 22-23) **National programme: Federal Republic of Germany.** Foehl, J. (Staatliche Materialpruefungsanstalt, Stuttgart, Germany, F.R.). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3372 (IWGRRPC—85, pp 24-25) **National programme: Sweden.** Eriksgaard, B. (Swedish Plant Inspectorate, Stockholm). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3373 (IWGRRPC—85, pp 25-30) **National programme: United States of America.** Steele, L.E. (Naval Research Lab., Washington, DC, USA. Thermostructural Materials Branch). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

The extensive programs of the US are supported principally by the Nuclear Regulatory Commission and the Electric Power Research Institute. The current and proposed programs of these groups were outlined after a background statement which described the current nuclear stalemate in the USA as well as the proposed basis for the summary programs. The latter involved a) an outline of the principal address of SMIRT by Dr. R. Vollmer, of USNRC, b) 1986 NRC research plan, c) the current and five year plans of the MEA Inc. for NRC, and d) the five year plan of EPRI as these addressed reliability of reactor pressure components. 1 tab.

3374 (NUREG/CR—4970) **Stainless Steel Round Robin Test: Centrifugally cast stainless steel screening phase.** Bates, D.J.; Doctor, S.R.; Heasler, P.G.; Burck, E. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Oct 1987. Contract AC06-76RL01830. 295p. (PNL—6266). NTIS, PC A13/MF A01 - GPO. Order Number DE88001701/JAW.

This report presents the results of the Centrifugally Cast Stainless Steel Round Robin Test (CCSSRRT). The CCSSRRT is the first phase of an effort to investigate and improve the capability and reliability of NDE inspections of light water reactor piping systems. This phase was a screening test to identify the most promising procedures presently available for CCSS. The next phase will be an in-depth program to evaluate the capability and reliability of inservice inspections (ISI) for piping. In the CCSSRRT, 15 centrifugally cast stainless steel pipe sections containing welds and laboratory-grown thermal fatigue cracks in both columnar and equiaxed base material were used. These pipe specimens were inspected by a total of 18 teams from Europe and the United States using a variety of NDE techniques, mostly ultrasonic (UT). The inspections were carried out at the team's facilities and included inspections from both sides of the weld and inspections restricted to one side of the weld. The results of the CCSSRRT make it apparent that a more detailed study on the capability and reliability of procedures to inspect stainless steel materials is needed to better understand the specific material and flaw properties and how they affect the outcome of an inspection.

3375 (SAND—87-2378C) **Insights from the US plant lifetime improvement program.** Carlson, D.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8710179—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001654/JAW.

From NEA/CSNI-UNIPEDE/NUCLE specialist meeting on life limiting and regulatory aspects of reactor core internals and pressure vessels; Stockholm, Sweden (14 Oct 1987).

The US nuclear industry, coordinated by the Nuclear Utility Plant Life Extension Steering Committee and supported by the US Department of Energy, Electric Power Research Institute, and various industry organizations, is investigating issues associated with extending licensed operation beyond 40 years. This paper presents insights from this program. While there still are a number of issues that require closer scrutiny, the initial conclusion is that life extension is feasible. Degradation mechanisms affecting the life expectancy of reactor pressure vessels and vessel internals are identified and assessed. Recommendations for enhancing the ability to predict the life of these components are presented as well. 7 refs.

3376 (STUK-B-YTO—40) **Operation of Finnish nuclear power plants. 4. quarterly report 1986 and annual summary.** Lehtinen, P. (comp.). (Finnish Centre for Radiation and Nuclear Safety, Helsinki. Dept. of Nuclear Safety). Jul 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753045/JAW.

Same report published in Finnish as STUK-B-YTO-36.

These general reviews of the operation of the Finnish nuclear power plants concentrate on such events and discoveries related to reactor and radiation safety that the regulatory body, the Finnish Centre for Radiation and Nuclear Safety, regards as noteworthy. The report also includes a summary of the radiation safety of the

personnel and the environment, as well as tabulated data on the production and load factors of the plants. No event in the report period, or in the whole year of 1986, essentially degraded plant safety nor posed a radiation hazard to the personnel or the environment. For remedying certain defects found in the adminstrative procedures concerning plant operation and maintenance, the Loviisa power plant was shut down for several days in September.

3377 **(STUK-B-YTO—41) Safety-related incidents at the Finnish nucleat power plants. 3. and 4. quarterly report 1986.** Lehtinen, P. (comp.). (Finnish Centre for Radiation and Nuclear Safety, Helsinki. Dept. of Nuclear Safety). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753046/JAW.

Same report published in Finnish as STUK-B-YTO-37.

This report contains detailed descriptions of safety-related incidents at the Finnish nuclear power plants. The descriptions include accounts of the practical actions due to the incidents and evaluations of their significance to nuclear safety. The most important criterion in selecting the events has been the general usefulness of the lessons learned. The incidents are also described in broad outline in the general Quarterly Reports: 'Operation of Finnish Nuclear Power Plants', which are supplemented by this report intended for experts.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 3098, 3368, 3369, 3370, 3371, 3372, 3373, 3374, 3375, 3376, 3377, 3424, 3450, 3452, 3457, 3458, 3459, 3460, 3461, 3462, 3466, 3473, 3475, 3476, 3477, 3478, 3480, 3481, 3483, 3484, 3486, 3489, 3491, 3492, 3503, 3506, 3508, 3509, 3510, 3512, 3518, 4003

3378 **(BMU—1987-147) Simulation of the core behaviour at TMI-2 incident by KESS-2. Final report.** Schmidt, F.; Bleher, G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1986. 104p. (In German). (IKE—4-122). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, Germany, F.R.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This work describes a simulation of the accident at the TMI-2 reactor by the core melt system KESS-2. The simulation covers the time range from the first uncovery of the core to the end of the second reflooding phase. Also it was tried to simulate the formation and the heat up of the debris bed. The results of the simulation could be adjusted quite well to the conditions in the reactor as they are presently known. Many processes which took place during the accident can now be interpreted more easily. Thus conclusions already drawn in the first part of this project are confirmed.

3379 **(CEA-CONF—8907) Evaluation OF PWR's operating experience. Significant events which influenced French nuclear power program.** Dupuis, M.C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 38p. (In French, English). (CEA-DAS—310; CONF-8610291—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753243/JAW.

From International meeting of nuclear reactor safety committees; Racine, PA, USA (20 Oct 1986).

This report discusses developments or changes in safety policy (whether statutory or otherwise) and in plant design and operation, which, in many cases, correlate. When considering these events, it is important to bear in mind the standardization policy characterizing the French nuclear power program, and implying central decision-making, both for the safety authorities and the operating utility.

3380 **(CEA-CONF—8947) Presentation of the pressurized water nuclear power plant REPSI.** Invernizzi, M.; Kaas, F.; Philbert, E. (CEA CEN Saclay, 91 - Gif-sur-Yvette, France. IRDI, DEIN; CEA CEN Grenoble, 38, France. Service des Piles; Institut National des Sciences et Techniques Nucleaires, CEN Saclay, 91 - Gif-sur-Yvette, France). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire). Nov 1986. 18p. (In French). (CONF-8611186—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753238/JAW.

From C.U.I.C. meeting; Saclay, France (13 Nov 1986).

REPSI, 900MW PWR reactor simulator, was designed at the INSTN (CEA) to answer pedagogic needs. This report presents the operation and electronic interface software, the simulation software, the use of REPSI, the fabrication of synoptics, the development of practical courses, and a balance of the first months of operation.

3381 **(DOE/ET/34212—53) Survey of cladding oxide thickness on extended burnup fuel rods.** Newman, L.W.; Papazoglou, T.P.; Mayer, J.T.; McInteer, W.A.; Pyecha, T.D.; Holman, P.L.; Aadland, P.C.; Jones, P.D. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Sep 1987. Contract AC02-78ET34212. 146p. (BAW—1819). NTIS (US Sales Only), PC A07/MF A01; 1; GPO Dep. Order Number DE88001588/JAW.

The Babcock and Wilcox Company, Duke Power Company, and The United States Department of Energy are participating in a joint project to qualify current design pressurized water reactor fuel assemblies for extended burnup, and to identify burnup-limiting concerns of this current design fuel to aid in developing advanced design fuels with even greater extended burnup capability. As part of this joint project, cladding oxide thicknesses were measured nondestructively both at poolside and in the hot cell for fuel rods with Zircaloy-4 cladding at rod-average burnups ranging from about 21,000 to 52,000 MWd/mtU. The performance of the nondestructive eddy-current measurement system was verified metallographically on fuel rods with a burnup of 40,000 MWd/mtU. Hot cell measurements also included cladding hydrogen content and pick-up fractions, hydride orientation, cladding tensile strength, and cladding ductility (elongation). These data were evaluated with respect to burnup, linear heat generation rate, incore operating time, axial location on the fuel rods, and reactor coolant chemistry. Also, a simplified in-reactor oxidation model (developed by Electric Power Research Institute/Combustion Engineering/Kraftwerk Union) was used to predict oxide thickness on fuel rods at the extended burnup conditions of 50,000 MWd/mtU through 1554 EFPD of core operation. The trends seen in the evaluation and the predictions made using this model indicate that uniform waterside corrosion and its secondary effect of hydrogen pick-up will not limit the routine operation of current design PWR fuel through burnups of ~50,000 MWd/mtU. 23 refs., 48 figs., 11 tabs.

3382 **(INIS-BR—879) Fabrication of mechanical components and piping design for Brazilian nuclear reactors.** Deppe, L.O. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 1p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700413/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

Published in summary form only.

3383 **(INIS-BR—887) Fabrication of mechanical components and piping design for Brazilian nuclear reactors.** Deppe, L.O. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 17p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700421/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

The supply of Brazilian equipment and piping design for Angra 2 (and Angra 3 in some cases) have reached an advanced

status in spite of the continuous outside difficulties which affect these nuclear power plants. The achieved quality is similar to the quality achieved in foreign countries and the nationalization program foreseen in 1975 is being largely surpassed. In this paper the actual situation is presented as well as the future perspectives.

3384 **(IWGRRPC—85) Seventh regular meeting of the International Working Group on Reliability of Reactor Pressure Components, Vienna, 3-5 September 1985. Summary report.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Reliability of Reactor Pressure Components). Jul 1986. 34p. (CONF-8509420—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW.

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

The seventh regular meeting of the IAEA International Working Group on Reliability of Reactor Pressure Components was held at the Agency's Headquarters in Vienna from 3 to 5 September 1985. The representatives of Member States and of the Commission of the European Communities reported the status of the research programmes in this field (12 presentations). A separate abstract was prepared for each of the presentations.

3385 (IWGRRPC—85, pp 10) **National programme: Commission of the European Communities.** Maurer, H. (Commission of the European Communities, Brussels, Belgium. Directorate General for Research, Science and Education). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3386 (IWGRRPC—85, pp 12-16) **National programme: Finland.** Forsten, J. (Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

Finland's programmes in the field of reactor pressure components are presented in this paper. The following information on each of these programmes is given: the brief description of the programme; the programme's schedule and duration; the name of the project manager.

3387 (IWGRRPC—85, pp 18-20) **National programme: Poland.** Zdankiewicz, M. (Urzad Dozoru Technicznego, Warsaw, Poland). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

The activities in the field of nuclear power engineering in Poland are mainly connected with the nuclear power plant now under construction at Zarnowiec (4x440 MW) as well as with the preparatory work targeted toward the construction of further nuclear power plant incorporating 1000 MW power units. These activities include two main lines: a) documentation (standards, regulations, guidelines etc.); b) research and development work.

3388 (IWGRRPC—85, pp 20-21) **National programme: German Democratic Republic.** Popp, K. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3389 **(NUREG/CR—4930) Crack-arrest behavior in SEN [single-edge notch] wide plates of quenched and tempered A 533 grade B steel tested under nonisothermal conditions.** Naus, D.J.; Bass, B.R.; Pugh, C.E.; Nanstad, R.K.; Merkle, J.G.; Corwin, W.R.; Robinson, G.C. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Aug 1987. Contract AC05-84OR21400. 168p. (ORNL—6388). NTIS, PC A08/MF A01 - GPO. Order Number DE88001596/JAW.

The first series of six wide-plate crack-arrest tests (WP-1 Series) are discussed in this report. Each test utilized a 1-m x 1-m x 0.1-m-thick single-edge notch specimen (a/w = 0.2), fabricated from A533 grade B class 1 steel, that was subjected to a linear thermal gradient along the plane of crack propagation. The tests were conducted at the National Bureau of Standards (Gaithersburg) and were designed to provide fracture-toughness measurements at temperatures approaching or above the onset of the Charpy upper-shelf regime, in a rising toughness region and with an increasing driving force. Results from this series of tests produced crack-arrest toughness values well above the limit recognized by current ASME Code guidelines (220 MPa . √m) with arrest occurring at 52°C to 115°C above the material RT/sub NDT/ (-23°C). The fracture data support: (1) the use of current LEFM concepts to analyze cleavage run-arrest events, (2) the treatment of cleavage run-arrest and ductile fracture modes as separate events, and (3) the fact that cleavage arrest occurs above the ASME limit. 115 figs., 20 tabs.

3390 **(STUK-A—69) Nondestructive measurements with a WWER-440 fuel assembly model using neutron and gamma sources.** Salmenhaara, S.; Tarvainen, M. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Feb 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753049/JAW.

Laboratory measurements were carried out in order to give a better insight to the behaviour of neutron and gamma radiation in spent nuclear fuel. A WWER-440 fuel assembly model containing fresh 3.6% enriched fuel was used together with a line-shaped gamma source or a neutron point source. The contribution of single fuel rods to the measured gamma signal was measured at different energies in the geometry used in real spent fuel measurements. The origin of the measured neutrons was detected by employing the neutron source. The so-called end effects of the assembly were examined, as well. Both a horizontal, using a fork detector, and a vertical detector geometry was studied. In fork detector measurements the neutrons were detected by means of cadmium-wrapped and bare fission chambers with boron concentrations of 2100 ppm and 4000 ppm in addition to pure water.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 3102, 3490, 3493, 3494, 3495, 3497, 3505, 3756

3391 **(CEA-R—5384) Sicral F1 graphite-core fuel element behavior in power reactors.** Rendu, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Feb 1987. 201p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750115/JAW.

Over 500 000 Sicral F1 graphite-core fuel elements have been manufactured by COGEMA to date and irradiated in GCR power reactors. Since 1963, this type of fuel element has been thoroughly investigated in design studies, in-core and out-of-core tests and post-mortem examinations. This report reviews the current state of knowledge on the irradiation behavior of the components under normal operating conditions and in incident situations (e.g. clad failure). It discusses how this work has led to optimization of the thermal, mechanical metallurgical and neutronic performance in order to obtain a can failure probability of less than 1.6 x 10/sup -5/, and defines general operating procedures for reactor implementation of this type of fuel element.

3392 **(INIS-BR—886) State-of-the-art of the fluidized bed nuclear reactor concept.** Sefidvash, F.; Vilhena, M.T.M.B. de; Streck, E.; Borges, V.; Johansson, M. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Helsinki Univ. of Technology, Finland). (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 11p. (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700420/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

A small and simple nuclear reactors with inherent safety using the fluidized bed concept is under research and study. In this paper a brief study neutronics and thermal hydraulics of this reactor concept is presented.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 4057

3393 **(DP-MS—86-193) Numerical modeling of a nuclear production reactor cooling lake.** Hamm, L.L.; Pepper, D.W. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 11p. (CONF-871207—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014834/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

A finite element model has been developed which predicts flow and temperature distributions within a nuclear reactor cooling lake at the Savannah River Plant near Aiken, South Carolina. Numerical results agree with values obtained from a 3-D EPA numerical lake model and actual measurements obtained from the lake. Because the effluent water from the reactor heat exchangers discharges directly into the lake, downstream temperatures at mid-lake could exceed the South Carolina DHEC guidelines for thermal exchanges during the summer months. Therefore, reactor power was reduced to maintain temperature compliance at mid-lake. Thermal mitigation measures were studied that included placing a 6.1 m deep fabric curtain across mid-lake and moving the reactor outfall upstream. These measurements were calculated to permit about an 8% improvement in reactor power during summer operation.

3394 **(NEI-NO—25) Annual report 1986 - IFE.** (Institute for Energy Technology, Kjeller (Norway)). 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753034/JAW.

At present Norwegian nuclear energy research is centered around the international OECD Halden Reactor Project which has participants from 40 organisations in 10 countries, including the Nordic countries and most major nuclear power countries within OECD. The research programme is concentrated on nuclear fuel and safety technology, and on computerbased methods for operation and supervision of power reactors. The paramount objective of fuel research at Halden is to produce experimental data that will increase insight into the fundamental factors affecting the reliability of the fuel under various operational conditions, and to obtain data for developing and qualifying analytical/empirical calculation models of fuel behaviour. Joint programme activities are increasingly being directed towards defining long-term effects that may influence the fuel's operational reliability. To follow up these progress trends, a special loop was installed in the reactor in 1986 for studying conditions affecting corrosion of fuel rods. Of prime significance in the development work is the advanced experimental control room which is connected to a full-scale simulator of a nuclear power plant of the PWR type. In 1986 the experimental control room was used for comparative studies of alarm systems based on conventional alarm displays and an advanced system developed by the Halden Project which are based on a colour screen display. The latter system eliminates alarms that are irrelevant to the current plant status, so reducing the volume of information reaching the operator. In 1986 work was also done on a major computerized system designed to assist operators under irregular operating conditions. The Project developed a module for early detection of irregularities, an expert diagnosis system to find causes, and a module whereby the operator is led through the procedures that must be followed in order to bring the process back to an acceptable state.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 2977, 3454, 3488, 3502, 3515, 3516, 3521, 4011, 4317, 4324

3395 **(CNEA-NT—28/85) Elements for evaluation of fast breeder reactor's potential in Argentina.** Gho, C.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Prospectiva y Estudios Especiales). 1985. 141p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700011/JAW.

Fast Breeder Reactors (FBR) main features are presented in a general form, including their physical principles, the history of their evolution, their relevant technological aspects and the basis for their comparison to other energy sources. This is completed with descriptions of typical reactors and a model of FBR penetration in the Argentine electrical network. It is recommended to form a multidisciplinary board to study which position should be taken with respect to this type of reactors. In the author's opinion a Research activity should be started and gradually increased for passing to Development activities after a short while.

3396 **(EUR—10638) Comparison of different LMFBR primary containment codes applied to a Benchmark problem.** Benuzzi, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750269/JAW.

The Cont Benchmark calculation exercise is a project sponsored by the Containment Loading and Response Group, a subgroup of the Safety Working Group of the Fast Reactor Coordinating Committee - CEC. A full-size typical Pool type LMFBR undergoing a postulated Core Disruptive Accident (CDA) has been defined by Belgonucleaire-Brussels under a study contract financed by the CEC and has been submitted to seven containment code calculations. The results of these calculations are presented and discussed in this paper.

3397 **(FEI—1678) Stochastic nonuniformities of temperature fields in deformed fuel assemblies of fast reactors.** Kazachkovskij, O.D.; Sorokin, A.P.; Zhukov, A.V.; Ushakov, P.A.; Kriventsev, V.I.; Titov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700323/JAW.

Technique of channel thermohydraulic calculation of imperfected fuel assemblies of fast reactors is described in brief specific features of subchannel coolant mixing in imperfected fuel assemblies (FA) are analyzed. It is shown that the effect of fuel assembly "ovalization" under swelling can essentially influence the intensity of subchannel coolant mixing. The results of analysis of geometrical parameters of a imperfected fuel assembly of the Phenix reactor are presented. Using the Phenix random geometry distortions of a imperfected assembly can affect temperature modes of fuel elements in the assembly. Essential leveling of temperature nonuniformities in imperfected assembly may be attained by using differently oriented wire wrapping on fuel elements. 29 refs.; 9 figs.

3398 **(FEI—1762) Numerical study of coolant flow in elements of reloading unit of a fast reactor.** Matyushina, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700328/JAW.

Flowrate and temperature fields in elements of a reloading unit of a liquid metal cooled tank-type fast reactor are numerically investigated. Navier-Stokes equation in Helmholtz form and the equation of heat transfer in liquid flow are solved. Comparison with experimental data is carried out. The suggested method of calcula-

tion permits to determine temperature and rate fields in channels of different forms. 3 refs.; 8 figs.

3399 **(FRCEA-TH—35) Contribution to the study of natural convection in a boiling medium with power density transfer.** Bede, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Grenoble-1 Univ., 38 (France)). Jan 1987. 358p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88750257/JAW.

This study has been carried out in the framework of fast reactor safety studies and deals with the fuel boiling problem in case of flow blockage at the bottom of a fuel assembly. The experimental part of this study bringgs new informations characteristic of a boiling fluid bath (water) simulating in a transient and in a steady regime (pressure, temperature, void fraction, heat flux at the walls). It points out a relation between heat losses through the walls and the importance of the monophase zone of the bath. A model has been developed from the analysis of experimental results. It is based on a quasi-stationary state and allows to find the evolution of the characteristic values in confined transient regime.

3400 **(IWGFR—62) IAEA specialist meeting on flow induced vibrations in fast breeder reactors; Summary report.** Perez, M.A. (ed.). (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). 1987. 307p. (CONF-8610225—Summ.). NTIS (US Sales Only), PC A14. Order Number DE87900922/JAW.

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

This report presents information concerning: fluid-structure interaction; calculation methods; tube bundles vibration and WEIR; instability; and induced vibrations in the pumps. (JDB)

3401 (IWGFR—62, pp 186-202) **Fluidelastic instability in tube arrays.** Chen, S.S.; Jendrzejczyk, J.A.; Wambsganss, M.W. (Argonne National Lab., IL, USA). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

When an array of tubes is subjected to crossflow, the tubes can experience dynamic instability, generally called fluidelastic instability. Instability initiates when the crossflow velocity exceeds a threshold value above which energy input from the flow exceeds that dissipated by system damping. Catastrophic failures of reactor and process plant equipment have been attributed to fluidelastic instability. As a result, extensive research studies have been conducted in the last 15 years with the objective of understanding the instability mechanisms and developing general design guidelines to avoid instability. Argonne National Laboratory has a continuing research program in this area which includes both mathematical model development and experimentation. This paper describes recent developments and accomplishments. Figs.

3402 (IWGFR—62, pp 203) **Vibration and wear of loosely supported heat exchanger tubes.** Goyder, H.G.D. (UKAEA Atomic Energy Research Establishment, Harwell). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3403 (IWGFR—62, pp 273-276) **Flutter of rods with artificial roughness in axial flow.** Fedotovsky, V.S.; Spirov, V.S.; Sinyavsky, V.F.; Terenik, L.V. Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The experimental investigation results on the vibration characteristics of the rods with artificial roughness in the axial flow are presented. It is shown that the roughness plays an important role in the mechanism of vibrations excitation. For the rods having artificial roughness with a relative size of 0.075+0.2 the phenomenon of dynamic instability has been revealed at the flowrates being by the order of magnitude smaller than those predicted by the Paidoussis theory. It is experimentally obtained that for the rods similar to those used as a nuclear reactor fuel element and heat exchanger tubes the critical velocities resulting in the vibration amplitude increase by the one or two order of magnitude are the values as much as 6-12 m/s. It is shown that the phenomenon revealed differs from a classic flutter by a number of attributes. 6 refs, 3 figs.

3404 (IWGFR—62, pp 284-296) **Vibrations of the shafts of the primary pumps: ROTOR: a finite element program for computing the vibrations of rotating shafts immersed in a liquid.** Axisa, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Etudes Mecaniques et Thermiques). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3405 **(IWGFR—62) IAEA specialist meeting on flow induced vibrations in fast breeder reactors, Paris, France, 22-24 October 1986. Summary report.** Perez, M.A. (ed.). (International Atomic Energy Agency, Vienna (Austria); CEA, 75 - Paris (France)). Oct 1986. 296p. (CONF-8610225—). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW.

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The Specialists' Meeting on "Flow Induced Vibrations in FBRs for LMFBR Applications" was held in Paris under the auspices of the French CEA on 21-24 October 1982. The meeting was sponsored by the IAEA on the recommendation of the 14th Meeting of the IWGFR and was attended by 31 participants from France, the Federal Republic of Germany, India, Italy, Japan, the United Kingdom, the Union of Soviet Socialist Republics, the United States of America and one international organization (IAEA). The meeting was presided over by Pr. R.J. Gibert of France. After the first session on review of national positions in the subject field (7 papers), the meeting was divided into five technical sections as follows: fluid-structures interaction, calculation methods (3 papers); tubes bundles vibration and weir (4 papers); instability (6 papers); induced vibrations in the pumps (2 papers). A separate abstract was prepared for each of these papers. Refs, figs and tabs.

3406 (IWGFR—62, pp 24-43) **CRIEPI's research activities on fluid-structure interaction. Current status and future plan.** Tanaka, N. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

This report summarizes the studies of fluid-structure interaction, which have been performed as a part of the LMFBR-related research program in CRIEPI. Future program plan starting from FY1987 is also described. Figs.

3407 (IWGFR—62, pp 44-55) **Flow induced vibration in LMFBRs. Development work in support of the UK programme.** Collinson, A.E. (UKAEA Risley Nuclear Power Development Labs.). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

In the UK flow-induced vibration of LMFBR components is assessed using a combination of theoretical and experimental approaches. Basic development work is carried out to allow more re-

liance in the future on theoretical methods, which requires better understanding of mechanisms involved where flow patterns are complex. In particular loose-tube vibration in heat exchangers, and the above-core region are being considered for experimental investigations of a generic nature. 4 refs, 6 figs.

3408 (IWGFR—62, pp 56-67) **Analysis of flow-induced vibrations in the PEC design.** Cornaggia, L.; Reale, M.; Martelli, A.; Zambelli, M. (Ansaldo S.p.A., Genoa, Italy; ENEA, Bologna, Italy. Fast Reactor Dept.). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

This paper summarizes the studies performed for the Italian PEC fast reactor test facility with regard to flow-induced vibration problems. Reference is made to the reactor-block, the primary and secondary coolant loops and the emergency loops. Studies in progress and future developments foreseen are also mentioned. 5 refs, 6 figs.

3409 (IWGFR—62, pp 68-92) **U.S. LMFBR Flow Induced Vibration Program (1977-1986). A summary and overview.** Wambsganss, M.W.; Chen, S.S.; Mulcahy, T.M.; Jendrzejczyk, J.A. (Argonne National Lab., IL, USA). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

This paper summarizes the activities and accomplishments under the U.S. LMFBR Flow Induced Vibration Program for the period 1977-1986. Since 1977 represents the date of the last IAEA IWGFR Specialists Meeting on Flow Induced Vibration, this paper provides an update to the results presented at that meeting. This period also represents a period of substantial change for the U.S. LMFBR program. A major reactor project, the FFTF, was completed and a second major project, the CRBR plant, was terminated. This change adversely impacted the U.S. Fiow Induced Vibration Program. Nevertheless, base technology activities have continued. In this paper, research in the following areas is summarized: Vibration Characteristics and Scaling, Turbulent Buffeting and Vortex Shedding, Fluidelastic Instabilities of Tube Bundles in Crossflow, and Instabilities Induced by Leakage Flows. 50 refs, 15 figs.

3410 (IWGFR—62, pp 93-116) **Activities on flow induced vibration within the FRG Fast Reactor Program, current status and future planning.** Rangette, A.; Schmidt, H. (Internationale Atomreaktorbau G.m.b.H., INTERATOM, Bergisch Gladbach, Germany, F.R.). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

This paper presents a general view of the procedure used to proof the structural integrity of SNR 300 reactor components subjected to vibrational loads. Current vibrational problems at the experimental fast reactor KNK II are outlined. A sketch of planned predesign activities on flow induced vibration problems for the SNR2 programme is given. 10 figs.

3411 (IWGFR—62, pp 117-149) **Flow-induced vibration of LMFBR's equipment elements measurements and calculation method development.** Kokorev, B.V.; Sinjavsky, V.F.; Fedotovsky, V.S.; Yurjev, Yu.S.; Titov, V.F.; Feodorov, V.G. Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

Consideration is given to the results of vibrational characteristics of BN-350 steam-superheater tubes, BN-600 NPP evaporator tubes and pipes, the results of BN-350 superheater tube wear after 56,000 hours of operating time. Note is taken of difficulties of real object vibrational characteristics prediction, a brief account is taken of the pressure and velocity field calculation methods in the bundles, dynamic properties of complex systems. Abnormal dynamic instability of artificial roughness rods in the longitudinal f fluid flow is reported. 12 refs, figs.

3412 (IWGFR—62, pp 150-158) **Development of 3-D fluid-structure interaction analysis code for FBR.** Soman, Y. (Mitsubishi Heavy Industries Ltd., Kobe, Japan. Kobe Shipbuilding and Engine Works). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3413 (IWGFR—62, pp 159-163) **Vibration analysis of a pool type LMFBR. Fluid-structures coupled modes and response to flow excitations.** Aita, S.; Bertaut, C.; Hamon, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Etudes Mecaniques et Thermiques; Novatome Industries, 92 - Le Plessis-Robinson, France). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

A comprehensive analysis in several steps was made in order to estimate the flow induced vibrations of SUPERPHENIX reactor internal structures. This analysis includes calculation and full-scale tests in air, fluid-structure modal calculation and limited verification by tests. In both cases, the calculation used a substructuration procedure. Excitation sources were estimated using reduced scale models. These sources were then introduced in the modal model of the complete fluid-coupled assembly in order to calculate the response in terms of displacements and stresses. The stress responses due to these sources revealed to be below the fatigue stress limits. Their maximum were localized at the points where strain gages were implemented for the control of the reactor behaviour during operation. 7 refs, 5 figs, 1 tab.

3414 (IWGFR—62, pp 171-185) **Flow induced vibration in the Superphenix heat exchanger bundles.** Axisa, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Etudes Mecaniques et Thermiques). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3415 (IWGFR—62, pp 203-209) **Flow induced vibration in LMFBRs. Development work in support of the UK programme.** Collinson, A.E. (UKAEA Risley Nuclear Power Development Labs.). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

Considerable effort has been devoted to understanding flow interaction in tube bundles as these feature prominently in heat exchangers (Steam Generator Unit, SGU and Intermediate Heat Exchanger, IHX) also in CDFR core support and above-core structure. Excitation data has been obtained at Reynolds Numbers Re 0.4-4 x 10/sup 5/ for a range of triangle pitch geometries appropriate to heat exchangers and at Re up to 2 x 10/sup 8/ for above core structure. In this paper basic tube-bundle development work is described first, to be followed by application to the various parts of the reactor to which it is appropriate, along with other vibration experimental work and future intentions. 4 refs, 6 figs.

3416 (IWGFR—62, pp 210-216) **Design and experimental substantiation of LMFBR IHX vibrostrength.** Zhukov, V.V.; Tatarsky, Y.N. Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The main results of design and experimental investigation of LMFBR IHXs' vibrostrength will be presented. On the basis of the analysis, vibrostrength of the IHX tube bundles is confirmed. 4 refs, 9 figs, 1 tab.

3417 (IWGFR—62, pp 217-220) **Fluidelastic instability in a flexible Weir: A theoretical model.** Aita, S.; Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Etudes Mecaniques et Thermiques). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

A new type fluidelastic instability was discovered during the hot tests of Superphenix LMFBR. This instability is due to the fluid discharge, over a flexible weir shell which separates two of these fluid sheets (the feeding and restitution collectors). An analytical nonlinear model was realised. The flow and force sources at the top of the collectors are described and projected on the modal basis of the system formed by the collectors and the weir shell. Simplified formulas were extracted allowing a practical prediction of the stability. More generally, the complete model can be used to estimate the vibratory level when a steady state is reached by the effect of nonlinearities. Computer calculation for such a model are made with OSCAR code, part of CASTEM 2000 finite element computer system. 12 refs, 7 figs.

3418 (IWGFR—62, pp 221-223) **Vibratory instability in Superphenix LMFBR: Discovery and solution.** Aita, S.; Gibert, R.J.; Verriere, P.; Bertaut, C.; Lacroix, C.; D'Onghia, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. d'Etudes Mecaniques et Thermiques; CEA, Centre d'Etudes Nucleaires de Cadarache, France. Dept. des Reacteurs a Neutrons Rapides; Novatome Industries, 92 - Le Plessis-Robinson, France; Electricite de France, 78 - Chatou. Lab. National d'Hydraulique; Societe Centrale Nucleaire Europeenne a Neutrons Rapides, NERSA, 69 - Lyon, France). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The Superphenix Reactor at CREYS MALVILLE (France) is a 1200 MWe pool type fast breeder reactor cooled by liquid sodium. The core is surrounded by thin axisymmetrical shells which separate sodium flow volumes and avoid thermal problems. During operation, these shells are excited by flow turbulence induced by the jet outlet of the core and of the intermediate heat exchangers. After the discovery of this instability, all partners involved in reactor project (Commissariat a l'Energie Atomique, NOVATOME, Electricite de France and NERSA) decided an effective task program in order to understand and determine a solution to the instability. Several aspects of these problems are discussed in this paper. 5 refs, 1 fig.

3419 (IWGFR—62, pp 224-228) **Fluidelastic instability of a flexible Weir: Experimental observations.** Aita, S.; Tigeot, Y.; Bertaut, C.; Serpantie, J.P. (CEA, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France. Lab. des Etudes de Vibrations et Seismes; Novatome Industries, 92 - Le Plessis-Robinson, France). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

A hydro-elastic instability was discovered during test operations of Super-Phenix LMFBR reactor. This instability is due to energy bringing by discharge to the fluid-structure system constituted by a flexible weir shell and adjoining fluid collectors. This paper describes the steps of the discovery and the results of the different measurements performed on site and on several mock-ups. The paper points out two typical instability mechanisms. It discusses similitude and leading parameters, for these mechanisms. And it then shows how theoretical and experimental results correlate well, allowing to find for the reactor an efficient solution to eliminate instability. 5 refs, 5 figs, 4 tabs.

3420 (IWGFR—62, pp 229-236) **Hydro-elastic study of instability of the cooling circuit of Superphenix.** Lacroix, C.; Viollet, P.L. (Electricite de France, 78 - Chatou. Lab. National d'Hydraulique). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3421 (IWGFR—62, pp 237-242) **Instabilities induced by leakage flows.** Mulcahy, T.M.; Wambsganss, M.W. (Argonne National Lab., IL, USA). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

3422 (IWGFR—62, pp 277-283) **Induced vibrations in the pumps: Experience with sodium pumps in the KNK.** Zimmermann, E. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen, Germany, F.R.). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The paper describes the experiences concerning the vibrations character at one primary sodium pump. Furthermore the exchange of the rotor runner, the knowledge at the removed part and the operating experiences with the new mounted rotor runner are explained. The vibrations behaviour between the old and the new rotor runner are shown by curves. The facts of continual increased vibrations and the possibilities to remove them will try to be explained. 10 figs.

3423 **(KFK—4245) Analysis of expansion phase experiments with improved approximation schemes.** Foit, J.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750176/JAW.

A steady-state flow of a single-phase and incompressible fluid across a singularity is studied. Based on these theoretical considerations new approximation methods for the pressure gradient term in the SIMMER-II momentum equations are proposed which give a satisfactory pressure change in flows across singularities. The expansion phase experiments with a dipplate performed by SRI-International are evaluated to examine the quality of the proposed approximation schemes.

3424 **(WAPD-TM—1604) Internal hydriding in irradiated defected Zircaloy fuel rods: A review (LWBR Development Program).** Clayton, J.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002086/JAW.

Although not a problem in recent commercial power reactors, including the Shippingport Light Water Breeder Reactor, internal hydriding of Zircaloy cladding was a persistent cause of

gross cladding failures during the 1960s. It occurred in the fuel rods of water-cooled nuclear power reactors that had a small cladding defect. This report summarizes the experimental findings, causes, mechanisms, and methods of minimizing internal hydriding in defected Zircaloy-clad fuel rods. Irradiation test data on the different types of defected fuel rods, intentionally fabricated defected and in-pile operationally defected rods, are compared. Significant factors affecting internal hydriding in defected Zircaloy-clad fuel rods (defect hole size, internal and external sources of hydrogen, Zircaloy cladding surface properties, nickel alloy contamination of Zircaloy, the effect of heat flux and fluence) are discussed. Pertinent in-pile and out-of-pile test results from Bettis and other laboratories are used as a data base in constructing a qualitative model which explains hydrogen generation and distribution in Zircaloy cladding of defected water-cooled reactor fuel rods. Techniques for minimizing internal hydride failures in Zircaloy-clad fuel rods are evaluated.

3425 **(WAPD-TM—1614) Nondestructive assay of spent fuel rods from a Light Water Breeder Reactor (LWBR Development Program).** Tessler, G.; Beaudoin, B.R.; Beggs, W.J.; Freeman, L.B.; Schick, W.C. Jr. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Sep 1987. Contract AC11-76PN00014. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88002088/JAW.

A gauge, called the Production Irradiated Fuel Assay Gauge (PIFAG), has been developed and utilized to measure, nondestructively, the fissile fuel content of spent fuel rods from the Light Water Breeder Reactor (LWBR) core. The PIFAG was in operation from November 1983 to May 1987. During this period, assay data were obtained for two irradiated test rods used for initial qualification of the gauge and 524 spent LWBR core rods. A review of PIFAG operations is given, including hot cell operations, calibration, assay operations, and methods used to monitor the data quality and verify the precision and accuracy of the data. The analytical model used to determine the core rod fissile fuel content from the data and the results for the 524 LWBR spent fuel rods are given.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

3426 **(SAND—87-1449) The effect of maximum-allowable payload temperature on the mass of a multimegawatt space-based platform.** Dobranich, D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001921/JAW.

Calculations were performed to determine the mass of a space-based platform as a function of the maximum-allowed operating temperature of the electrical equipment within the platform payload. Two computer programs were used in conjunction to perform these calculations. The first program was used to determine the mass of the platform reactor, shield, and power conversion system. The second program was used to determine the mass of the main and secondary radiators of the platform. The main radiator removes the waste heat associated with the power conversion system and the secondary radiator removes the waste heat associated with the platform payload. These calculations were performed for both Brayton and Rankine cycle platforms with two different types of payload cooling systems: a pumped-loop system (a heat exchanger with a liquid coolant) and a refrigerator system. The results indicate that increases in the maximum-allowed payload temperature offer significant platform mass savings for both the Brayton and Rankine cycle platforms with either the pumped-loop or refrigerator payload cooling systems. Therefore, with respect to platform mass, the development of high temperature electrical equipment would be advantageous. 3 refs., 24 figs., 7 tabs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 3375, 3443

3427 (INIS-mf—11045, pp 809-824) **Safety and licensing requirements in the Republic of South Africa.** Simpson, D.M.; Langford, E.L. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The principles for licensing of nuclear installations in South Africa are based on the control of mortality risk to the operators of an installation and the population resident in the vicinity of the site. This paper describes the development of this safety philosophy, and the nuclear licensing process used in this country. The structure of the nuclear regulatory function is briefly described, including the respective roles of the Atomic Energy Corporation, Licencing Branch and the Council for Nuclear Safety. The development of risk criteria and quantitative release magnitude-probability criteria for radioactive material is outlined. Tasks that have to be undertaken by a potential waste disposal site licensee before a site licence is issued are described. Once the facility is commissioned periodic monitoring procedures will have to be adopted throughout the lifetime of the facility. The scope of typical monitoring activities is outlined and the ongoing analyses to be performed and the records to be kept are discussed.

3428 **(NUREG—1232-Vol.1) Safety Evaluation Report on Tennessee Valley Authority: Revised Corporate Nuclear Performance Plan.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Special Projects). Jul 1987. 62p. NTIS, PC A04/MF A01 - GPO. Order Number DE88900025/JAW.

The TVA Corporate Nuclear Performance Plan addresses those corporate concerns identified by the NRC staff. Because much of the TVA corporate plan is programmatic, its effectiveness depends on its implementation, and the NRC staff plans to closely monitor this implementation. The NRC staff will address site-specific concerns in subsequent SERs on each volume of the Nuclear Performance Plan. On the basis of its review, the NRC staff finds TVA's revised Corporate Nuclear Performance Plan (Revision 4) acceptable. The NRC staff concludes that the organization and staffing of TVA's Office of Nuclear Power and the programmatic improvements in place or under way are sufficient, if implemented properly, to resolve the problems at the corporate level that led to issuance of the 10 CFR 50.54(f) letter dated September 17, 1985, and to support continuing TVA nuclear activities, including plant operations. 19 refs., 3 figs.

2108 Economics

REFER ALSO TO CITATION(S) 3514

3429 **(KTM/E-B—59) Use of decision analytic techniques in energy policy decisions.** Haemaelaeinen, R.P.; Seppaelaeinen, T.O. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Aug 1986. 108p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753038/JAW.

The report reviews decision analytic techniques and their applications to energy policy decision making. Decision analysis consists in techniques for structuring the essential elements of a decision problem and mathematical methods for ranking the alternatives from a set of simple judgments. Because modeling subjective judgments is characteristic of decision analysis, the models can incorporate qualitative factors and values, which escape traditional energy modeling. Decision analysis has been applied to choices among energy supply alternatives, siting energy facilities, selecting nuclear waste repositories, selecting research and development projects, risk analysis and prioritizing alternative energy futures. Many applications are done in universities and research institutions, but during

the 70's the use of decision analysis has spread both to the public and the private sector. The settings where decision analysis has been applied range from aiding a single decision maker to clarifying opposing points of view. Decision analytic methods have also been linked with energy models. The most valuable result of decision analysis is the clarification of the problem at hand. Political decisions cannot be made solely on the basis of models, but models can be used to gain insight of the decision situation. Models inevitably simplify reality, so they must be regarded only as aids to judgment. So far there has been only one decision analysis of energy policy issues in Finland with actual political decision makers as participants. The experiences of this project and numerous foreign applications do however suggest that the decision analytic approach is useful in energy policy questions. The report presents a number of Finnish energy policy decisions where decision analysis might prove useful. However, the applicability of the methods depends crucially on the actual circumstances at hand.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 3470

3430 **(AAEC/E—626) MIRANDA - a module based on multiregion resonance theory for generating cross sections within the AUS neutronics code system.** Robinson, G.S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1985. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700286/JAW.

MIRANDA is the cross-section generation module of the AUS neutronics code system used to prepare multigroup cross-section data which are pertinent to a particular study from a general purpose multigroup library of cross sections. Libraries have been prepared from ENDF/B which are suitable for thermal and fast fission reactors and for fusion blanket studies. The libraries include temperature dependent data, resonance cross sections represented by subgroup parameters and may contain photon as well as neutron data. The MIRANDA module includes a multiregion resonance calculation in slab, cylinder or cluster geometry, a homogeneous B/sub L/ flux solution, and a group condensation facility. This report documents the modifications to an earlier version of MIRANDA and provides a complete user's manual.

3431 **(CEGB-TPRD/B—0863/R86) Decay heat predictions using JEF1.** Tobias, A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 34p. (CNDC—86-P10). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750231/JAW.

The first Joint Evaluated File (JEF1) of data for reactor calculations has been constructed under the auspices of the NEA Data Bank. The data available within JEF1 for the calculation of decay heat due to direct fission products has been examined and the evaluation procedures used to produce these data are described. Decay heat predictions using the JEF1 data have been compared with corresponding values obtained with the UK data files. Differences of up to a few percent are observed in the predictions for a fission pulse. These occur mainly at short cooling times and can be attributed to revised fission yield data. For practical applications the differences in integral predictions using JEF1 and UK data are shown to be much smaller. UK and JEF1 total decay heat predictions have also been compared with results of a least squares fit to measured data for both U235 and Pu239 and directly with results of measurements for U238 and Pu241. The principal decay heat nuclides at a cooling time of 1000 s were identified and it was found that, for a number of them, the decay characteristics had been determined from relatively few measurements. It was also shown that the decay data for these nuclides, present in both UK and JEF1 data libraries, offered scope for revision which would permit improvement in the agreement between measurement and prediction. As plans for JEF2 are prepared, consideration should be given to improve decay heat predictions. It has been shown that while there is a general requirement for further data on short lived nuclides there is also a specific need to re-examine experimentally the decay schemes of a number of fission products with effective half lives of around 1000 s.

3432 **(FEI—1679) RZA program complex for multigroup two-dimensional calculation of a reactor in the ranges of neutron slowing-down and thermalization taking into account burnup.** Artem'ev, N.I.; Dekusar, V.M.; Kalashnikov, A.G.; Moseev, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700324/JAW.

Methods for multigroup calculation of neutron physical reactor characteristics containing strong shielding burnable poisons are described in two-dimensional (R, Z)-geometry. The calculation consists in two main stages: the first one is the calculation including burnup of heterogeneous cells characterizing physical reactor cores; the second - the proper calculation of the reactor on the basis of homogenized macro- and micro cross sections obtained during cell calculations. Cell calculation is carried out by DS-method. To solve the equations describing change in the isotope composition, the combination of Runge-Kutta and Adams methods are used. "Through" calculation of spatial energy distribution of neutron flux density in the region of deceleration and thermalization is carried out at P/sub 1/ or diffusion approximations. Spatial distribution of neutron flux density in every energy group of the reactor is determined by means of the effective modification of the method of variable directions. Constant soft ware is built on microconstat libraries: 21-group in the region of thermalization. 10 refs.

3433 **(FEI—1800) Equations of macrotransport in reactor fuel assemblies. Multiphase flows.** Sorokin, A.P.; Zhukov, A.V.; Kornienko, Yu.N.; Ushakov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700330/JAW.

The rigorous statement of equations of macrotransport is obtained. These equations are bases for channel-by-channel methods of thermohydraulic calculations of reactor fuel assemblies within the scope of the model of discontinuous multiphase coolant flow (including chemical reactions); they also describe a wide range of problems on thermo-physical reactor fuel assembly justification. It has been carried out by smoothing equations of mass, momentum and enthalpy transfer in cross section of each phase of the elementary fuel assembly subchannel. The equation for cross section flows is obtaind by smoothing the equation of momentum transfer on the interphase. Interaction of phases on the channel boundary is described using the Stanton number. The conclusion is performed using the generalized equation of substance transfer. The statement of channel-by-channel method without the scope of homogeneous flow model is given. 25 refs.; 2 figs.

3434 **(JAERI-M—86-190) Vectorization of continuous energy Monte Carlo code VIM.** Suganuma, Masayuki; Higuchi, Kenji; Asai, Kiyoshi. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700059/JAW.

VIM is a continuous energy Monte Carlo code for criticality calculation. The random walk control system which uses combinatorial geometry system has been vectorized on FACOM VP-100. Vectorization has been done by the event bank method which controls simultaneous multiple particle's random walks, since behavior of neutron is independent. In vectorization of VIM code, we have two problems. One is a large overhead introduced by program modifications for vectorization. Another is a lowering of vector processing efficiency, since the vector length decreases with time according to the absorption and leakage of neutron and cut off of neutron for variance reduction. The average vector length during the random walks has been kept long by utilizing cross section library of single energy band and by reducing the number of the event banks. The performance ratio of vectorized version to the original one is 1.39 for the simple geometry and 1.13 for the complex geometry.

3435 **(LA—10983-MS) Transport calculations for nuclear analyses: Theory and guidelines for effective use of transport codes.** O'Dell, R.D.; Alcouffe, R.E. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001939/JAW.

This report is for the serious user of discrete ordinates transport computer codes for performing nuclear analysis calculations. The first section after the introduction provides a reasonably thorough mathematical description of the analytic Boltzmann transport equation. Next is a section on the numerical discretization of the energy, angle, and space variables in the transport equation, along with an introduction to the source iteration method. The fourth section provides numerical details and features pertinent to discrete ordinates codes. That section details angular quadrature, spatial discretization methods, iteration acceleration methods, and search capabilities. The fifth section presents considerations in choosing a discrete ordinates code for use, and this is followed by a section on typical discrete ordinates codes available throughout the world. The report ends with some guidance for the user. 73 refs., 18 figs., 13 tabs.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 3455, 3507, 3809, 4038, 4063, 5339

3436 **(FEI—1550) Water departure nucleate boiling in an ring channel with two-sided heating.** Gal'chenko, Eh.F.; Kapinos, G.A.; Remizov, O.V.; Sergeev, V.V.; Yurkin, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700321/JAW.

Worsening of heat exchange when water flowing upwards in an annular channel with the size of 28x32 mm during heating of outer and inner tubes by alternative current is experimentally investigated. Experiments are carried out at 9.8-17.8 MPa and 300-865 kg/(m/sup 2/ x s) mass velocities. Data on critical void fraction and coefficients of convective heat transfer beyond the departure nucleate boiling zone are given. Applicability of the formula for determination of boundary void fractions in annular channels with one-sided heating in case of twosided heating channels is proved. 9 refs.; 9 figs.; 1 tab.

3437 **(FEI—1661) Numerical studies of heat transfer in chess-board rod bundles flowed round by coolants with moderate Prandtl numbers.** Buleev, N.I.; Zinina, G.A.; Mironovich, R.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700322/JAW.

The results of numerical study on heat transfer in turbulent fluid flows with moderate Prandtl numbers in regular triangular rod lattices are given. The input equations of motion and heat transfer are solved using the three-dimensinal model of turbulent exchange. The results of calculation of different characteristics of temperature fields in the cel of a triangular rod lattice in the wide range of values of problem parameters. The results of calculation of the Nusselt numbers are compared with the experimental data obtained. 10 refs.; 11 figs.; 1 tab.

3438 **(FEI—1726) New approach to nonuniformity classification and systematization of experiments on ionization radiation transfer trough nonuniformities in shielding.** Nikolaev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700327/JAW.

A new classification of nonuniformities in nuclear power plant shielding is suggested. Basing on this classification an approach to solving the problem on ionization radiation transfer through nonuniformities using three-dimensional calculation programs is suggested. Systematization of experiments on ionization radiation transfer through nonuniformities in shielding which makes it possible to check three-dimensional calculation program suitability for these purposes, the experimental data being a minimum, is carried out. Criteria for selection of experiments are suggested. 5 refs.; 1 tab.

3439 **(FEI—1805) Use of a local heat source for determining temperature of inlet heat section in ring channels.** Gol'ba, V.S.; Orlov, Yu.I.; Chernetskij, E.I.; Rachkov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700332/JAW.

A numerical method to obtain the temperature field for the inner wall of an annular channel behind a local heat source place on the same wall for from the source is described. Experimental data on temperatures of the inner wall of the annular channel around the local heat source are presented. Nu numbers for the initial section of the inner wall of the annular channel, when the constant heat flux from this surface being presented, as an example of concrete application of the methods suggested are calculated. 3 refs.; 4 figs.

3440 (IWGRRPC—85, pp 17) **National programme: Switzerland. Addendum to the note research activities in materials assessment and selection, fracture mechanics and nondestructive testing in Switzerland of July 1974.** Njo, D.H. (Swiss Nuclear Safety Dept., Wuerenlingen). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3441 (IWGRRPC—85, pp 21-22) **National programme: Hungary.** Gillemot, F. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1986. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700462/JAW. (CONF-8509420—).

From 7. regular meeting of the International Working Group on Reliability of Reactor Pressure Components; Vienna, Austria (3 Sep 1985).

3442 **(NUREG/CR—4926) An assessment of loss-of-containment potential because of knuckle buckling for 4:1 steel containment heads.** Bennett, J.G. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Apr 1987. Contract W-7405-ENG-36. 220p. (LA—10972-MS). NTIS, PC A10 - GPO. Order Number TI88001909/JAW.

4:1 diameter-to-height rise ratio torispherical nuclear steel containment head geometries were investigated experimentally and analytically for effects of knuckle buckling from internal pressure. The particular focus of the program was to assess the loss-of-containment potential. So the experiments were carried to rupture when feasible. Results of both small-scale tests and two large-scale (1/8) tests are reported. Significant ratios of knuckle buckling to design pressures were found (1.6 to 2.4). In addition, very large rupture pressure to design pressure ratios (7 to 7.5) indicate adequate reserve margin for loss-of-containment for these geometries and materials. A copy of the contractor's final report is included.

3443 **(PNL—6275) SAFT-UT utilities: Guide to SAFT-UT principles and conventions.** Hall, T.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001707/JAW.

This guide, the Guide to SAFT-UT (Synthetic Aperture Focusing Technique-Ultrasonic Testing), Principles and Conventions, is intended to provide the user with an overall background for practical implementation of SAFT-UT and the associated software utilities. It is not intended to exhaustively cover each related item, but rather to supply information from theory and experience that will assist the serious user in exploiting the robust nature of the SAFT technology. Chapter 1 gives an introductory overview from a historical perspective, emphasizing the need to maintain data integrity throughout the SAFT-UT imaging process. Chapter 2 in-

cludes a theoretical description of the Three SAFT-UT configurations currently being supported (single transducer pulse-echo, TSAFT, and TSAFT-2). A general description of the software tools is given in Chapter 3. It describes the major utilities and the general use of each one. Chapter 4 deals with the system resolution and sampling demands of SAFT-UT. A discussion of the strengths and limitations of the SAFT technique is provided in Chapter 5. The scanning conventions assumed throughout the implementation of the SAFT-UT utilities are detailed in Chapter 6. Chapter 7 lists an exhaustive supply of references for the user desiring to investigate the SAFT technology further. 26 refs., 19 figs.

3444 **Physics and technology of nuclear materials.** Ursu, I. Elmsford, NY; Pergamon Books Inc. (1985). 528p. Pergamon Books Inc., Manager/Publishing Services, Maxwell House, Fairview Park, Elmsford, NY 10523.

The author presents in this volume information on nuclear materials, the interaction of radiation with matter and research and development work on isotopic separation and related industrial applications. Contents include: elements of nuclear reactor physics; full materials, moderator materials; coolant materials; nuclear fuel elements; quality control of nuclear materials; and, materials for fusion reactors.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 3433, 3470

3445 **(IAEA-TECDOC—415) Development of computer models for fuel element behaviour in water reactors. Survey report of a co-ordinated research programme on the development of computer models for fuel element behaviour in water reactors.** Gittus, J.H. (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700018/JAW.

Description of fuel behaviour during normal operation transients and accident conditions has always represented a most challenging and important problem. Reliable predictions constitute a basic demand for safety based calculations, for design purposes and for fuel performance. Therefore, computer codes based on deterministic and probabilistic models were developed. Possibility of comprehensive descriptions of the phenomena is precluded in view of the great number of individual processes, involving physical, chemical, thermohydraulical and mechanical parameters, to be considered in a wide range of situations. In case of fast thermal transients predictive capability is limited by the kinetics of evolution of the system and its eventual dynamic behaviour. Evidently, probabilistic approaches are also limited by the sparcity and limited breadth of the impirical data base. Code predictions have to be evaluated against power reactor data, results from simulation experiments and, if possible, include cross validation of different codes and validation of sub-models. Progress on this subject is reviewed in this report, which completes the co-ordinated research programme on 'Development of Computer Models for Fuel Element Behaviour in Water Reactors' (D-COM), initiated under the auspices of the IAEA in 1981. 73 refs, 19 figs, 4 tabs.

3446 **(INIS-mf—10727) Changes of the inventory of radioactive materials in reactor fuel from uranium in changing to higher burn-up and determining the important effects of this.** Kirchner, G.; Schaefer, R. (Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.); Institut fuer Angewandte Oekologie, Darmstadt (Germany, F.R.). Projektgruppe Reaktorsicherheit; Bremen Univ. (Germany, F.R.)). Apr 1985. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750154/JAW.

Werkstattreihe.; No. 15.

The knowledge of the nuclide composition during and after use in the reactor is an essential, in order to be able to determine the effects associated with the operation of nuclear plants. The missing reliable data on the inventory of radioactive materials resulting from the expected change to higher burn-ups of uranium fuels in West Germany are calculated. The reliability of the program system used for this, which permits a one-dimensional account taken of the fuel rod cell and measurement of the changes of specific sets of nuclear data depending on burn-up, is confirmed by the comparison with experimentally found concentrations of important nuclides in fuel samples at Obrigheim nuclear power station. Realistic conditions of use are defined for a range of burn-up of 33 GWd/t to 55 GWd/t and the effects of changes of the number of cycles and the use of types of fuel elements being developed on the composition of the inventory are determined. The plutonium compositions during use in the reactor are given and are tabulated with the inventory for decay times up to 30 years. Effects during change to higher burn-ups are examined and discussed for the maximum inventories during use of fuel and for heat generation during final storage.

3447 **Fuel morphology effects on the chemical form of iodine release from severely damaged fuel.** Cronenberg, A.W.; Osetek, D.J. (ESA, Inc., Idaho Falls, ID, USA; Idaho National Engineering Lab., Idaho Falls, USA). *Journal of Nuclear Materials;* **149**: No. 2, 252-260(Jul 1987). Contract AC07-76ID01570.

Fission product release data for Xe, I, and Cs have been obtained from recent in-pile severe fuel damage experiments under simulated TMI-2 type accident conditions. Fresh fuel was trace-irradiated to a burnup level of 90 MWd/t just prior to testing to ensure the generation of both short- and long-lived fission product isotopes. The data indicate that for low-burnup fuel atomic I and Cs release is favored rather than molecular CsI. An a priori assumption of cesium-iodide (CsI) release from low-burnup fuel for risk analysis may therefore be inappropriate.

2204 Control Systems

3448 **(BMU—1987-151) Optimizing the human engineering design of control panels in nuclear power plant control rooms.** Behrendt, V.; Krehbiehl, T.; Hartfiel, H.D.; Mannhaupt, H.R.; Preuss, W.; Thomas, D.B. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.); Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.); Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.). Inst. fuer Biomedizin und Ergonomie; Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Unfallforschung). Dec 1986. 341p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, Germany, F.R.

The study contains two parts. In the first part an analytical procedure is developed to logically and reproducibly subdivide the control room personnel tasks resulting in a list of the elements (operations) and the structure (operations scheme) of a task. The second part lists together all knowledge of and influences on human engineering which are known at this time and which should be taken into account in designing control rooms. The content of this catalogue can best be used and presented by using a personal computer. Two fundamental different ways are possible to use the catalogue. Designing new control rooms or new parts of control rooms the results of the task analysis which should be done first, should guide the search in the catalogue to find the right human engineering factors. For assessing existing control room panels the performance shaping factors which are establishing the table of content, permit a quick access to the catalogue. Both the specific procedure of the task analysis and the different ways of access to the catalogue of human engineering knowledge for designing nuclear power plant control rooms have been proven by experienced system engineers and safety experts. The results are presented. They have been considered in this version of the study.

3449 **(EUR—10981) Qualification, training, licensing/authorization and retraining of operating personnel in nuclear power plants. Noteworthy topics identified by evaluation of the practices in countries of the European Communities.** Kraut, A.; Pfeffer, W. (Commission of the European Communities, Luxembourg). 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750481/JAW.

In the report EUR 10118 " Qualification, training, licensing and retraining of operating shift personnel in nuclear power plants"

the current practice in the countries of the European Communities as well as the procedures and programmes applied in Sweden, Switzerland and the USA are outlined and evaluated. The intent was to derive fundamental and generally valid concepts concerning shift-staff training and other relevant aspects. Those items were identified that seemed to be noteworthy because they give some guidance on how to achieve and maintain the qualification of the shift staff of NPPs or how to improve the staffing of the control room. These noteworthy topics identified by evaluation of the practice in countries of the European Communities and also elsewhere are presented in the publication at hand. The report addresses the following topics: tasks of the shift personnel, nomenclature for different grades of the personnel; shift staffing and staffing of the control room; criteria for personnel selection when recruiting new shift staff; personnel qualification necessary for recruitment; training of shift personnel; retraining and preservation of qualification standards; training facilities, especially simulators; responsibility for training; licensing/authorization; retirement from shift work. Consideration of these more general aspects and concepts may lead to improvement in training. The job descriptions given in the Annex to the document are only intended to give a general understanding of the typical designations, tasks and responsibilities of shift staff.

3450 **(FR-CEA-TH—31) Contribution on physics measurements using a modulated source of radiations applied to nuclear plants.** Rimbaud, C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Grenoble-1 Univ., 38 (France)). Jan 1987. 171p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750085/JAW.

In this work, measurements methods were studied with applications concerning pressurized water reactor (PWR), and reprocessing Plants. The aim of these measurements is to assess some of the characteristics of a physical medium by the use of a source of radiations (neutron or gamma) and of a convenient signal processing (averaging, Fourier transform). By using a modulation system, the Fourier transform enables us to extract the signal from the background noise (issuing either from the measurement system, either from the physical medium itself). The applications, that have been carried out, are: the measurement of the void fraction in the hot leg of a PWR by modulated gamma transmission and the measurement of the quantity of fissile material in reprocessing plants by the use of modulated source of neutron.

3451 **(INIS-BR—884) IPR-R1 reactor power control by the gamma radiation of N16.** Stasiulevicius, R.; Maretti Junior, F. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 10p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700418/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

The IPR-R1 reactor power control is realized by the ion chambers use. The information that the chambers send to the control console are deformed due the control rods movements during the operation. With the purpose to eliminate these interferences, was installed close the reactor water cooling circuit, one power control auxiliary system using the detection of the N 16 formed in the water. this paper presents an analysis of the results and propose one complete project that permits the control of the radioactives nuclides localized in the reactor cooling water.

3452 **(INIS-BR—885) Utilization of a full-scope simulation for training the operating personnel of nuclear power plants.** Mathias, S.G. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 10p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700419/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

A full-scope simulator of the Angra-2 Nuclear Power Plant has been installed at the NUCLEBRAS Training Center in Mambucaba - close to the site where that Plant is being built -, the goal of providing training for the operating personnel of the KWU-design nuclear power plants to be installed in Brazil. Due to the delays which occurred in the construction of Angra-2, NUCLEBRAS has established an extensive program for the utilization of the simulator for the training of operators for German nuclear power plants and for Spain's Trillo Plant. Besides yielding profits to NUCLEBRAS, that program is resulting in considerable experience in the area of nuclear power plant operators' training generating international recognition to the NUCLEBRAS Training Center.

3453 **(INIS-mf—10967) Early detection of nucleate boiling and spectral analysis of acoustical noise.** Bouneder, M. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Jan 1987. 95p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700037/JAW.

Figs. .

The development of a reliable detection technique for the onset of boiling has been further pursued. Besides the already studied tube geometry, a more realistic annular set up has been used where a fuel pin model, electrically heated, is placed. Using accelerometers on the pin, on the structure and on specific instrumentation cables the onset of boiling was clearly monitored by the emergence of a typical resonance frequency. The influence of pressure and heat power was analysed in detail. Furthermore, a glass model has been constructed in order to better correlate the observed measurement with the boiling parameters, as bubble radius, frequency and collapse mode. figs.

3454 (IWGFR—62, pp 243-272) **Flow-induced vibration experimental analysis of the hold-down and shut-down systems of the PEC fast reactor.** Castoldi, A.; Macarti, M.; Zola, M.; Antonucci, A. (ISMES, Bergamo, Italy; Nucleare Italiana Reattori Avanzati S.p.A., NIRA, Genoa). Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The experimental research this technical report deals with was carried out by the Dynamic Test Department of ISMES, Bergamo, Italy, on the Hold Down System (DBN) and on the Shutdown System of the PEC Sodium Cooled Fast Breeder Reactor, on behalf of NIRA, Genova, Italy. This report discusses some aspects particularly related to the experimental details of the research, such as: criteria for the simulation of the actual environment, design of mock-ups of some components, tests design, instrumentation and excitation equipment, criteria for test data processing etc. A more complete description of the research, and particularly of its results, is reported in reference 1. The report contents are the following: chapter 1 gives a short description of the PEC reactor and of the objective of the research; chapter 2 describes the components under test; in chapter 3 the test rig is shown, explaining the basic criteria for the reproduction of the environmental conditions; chapter 4 describes the tests performed; chapter 5 is dedicated to the description of the excitation, measuring and data processing equipment; chapter 6 describes thoroughly the processings carried out on the data recorded during the tests; finally in chapter 7 a short review of the main results obtained is made. 12 refs, 49 figs, 12 tabs.

3455 **(Juel—2107) Noise thermometry in nuclear power plants. A contribution to signal transmission of broad band spectra in noise thermometry.** Hoewener, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Dec 1986. 199p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750428/JAW.

Since in many applications (e.g. in nuclear reactors) the measuring sensor cannot be easily replaced, the value of the sensor resistance, as well as the selection of transmission lines with respect to good transmission characteristics of the whole arrangement and minimizing the correlative error terms, must already be optimized when designing a noise thermometer arrangement for the reasons mentioned above. The TRARAU computer program was developed for this purpose enabling the influences of the lines to be computed by taking into consideration all the effects occurring through the lines, such as transmission errors and correlative error terms. In order to check the accuracy of the TRARAU computer program a

series of laboratory measurements were implemented enabling both the pure transmission behaviour of the line arrangement with respect to the measuring signal to be detected, as well as the overall line error. In all cases this resulted in a very good agreement of the measured values with the computed values. The transmission behaviour of noise thermometer arrangements occurring in practice were studied with an Na experiment in BR2 (Mol), and with the measurement of the primary coolant temperature in the GKN (Neckar reactor, PWR). In both cases it was possible to demonstrate successfully the potential of the computer program TRARAU.

3458 **(RISO-M—2587) Training diagnostic skills for nuclear power plants. Final report of the NKA project LIT-4.** Goodstein, L.P. (ed.). (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark); Nordisk Ministerraad). Nov 1986. 113p. (LIT—85-6; NKA/LIT—85-6). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752878/JAW.

Operators of large-scale industrial process plants such as nuclear power stations and chemical plants are faced with a critical and complex task when confronted with disturbances in normal operation caused by technical failures or maintenances errors. Great care must be taken to prepare and support the operators during such situations. Procedural systems are provided, trained on full-scale highfidelity simulators is often a prerequisite and decision-support systems are starting to be incorporated, especially in modern control rooms. During recent years, it has become increasingly clear from "real-life" studies in complex production and transport industries that professional highly skilled troubleshooters can develop effective general purpose search strategies for locating and dealing with faults and, most importantly, with new and not previously experienced faults. This research has indicated that means for training of these general diagnostic abilities can be developed. In addition, other work has dealt with the problem of observing and analyzing operator behaviour in coping with disturbances. The NKA/LIT-4 project has continued these efforts in studying methods for training diagnostic skills as well as for observing and testing operator behaviour on training simulators. 25 refs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 3393, 3447, 3477, 3496, 3507, 3508, 4316, 4324, 4329, 4335, 5140

3457 **(DOE/SSDP—0020) Shippingport Station Decommissioning Project Technology Transfer Program.** Broom, C.A.; McKernan, M.L. (Westinghouse Hanford Co., Shippingport, PA (USA)). 1987. Contract AC06-84RL10421;AC06-76RL01857. 4p. (CONF-871018—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000606/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program, which was established to ensure that project information is adequately documented and subsequently made available for future decommissioning use.

3458 **(DOE/SSDP—0021) Shippingport Station Decommissioning Project: An overview and status report.** Schreiber, J.J. (USDOE Shippingport Station Decommissioning Project Office, PA). 1987. Contract AC06-84RL10421;AC06-76RL01857. 8p. (CONF-871018—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000605/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper presents an overview and current status of the Shippingport Station Decommissioning Project (SSDP). 2 tabs.

3459 **(DOE/SSDP—0022) Practical radiation, contamination and asbestos control techniques for decommissioning.** Giordano, R.J.; Gardner, D.L.; Taylor, C.A. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations). 1987. Contract AC06-84RL10421;AC06-76RL01857. 18p. (CONF-871018—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000608/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper presents the experiences and lessons learned as radioactive material and asbestos were encountered during the decommissioning of the Shippingport Atomic Power Station. The experience and lessons learned from work with radioactivity and asbestos together include discussions of the personnel and material access control, and the development of work and clearance procedures. Procedures especially adaptable to decommissioning were used to control contamination and airborne radioactivity during thermal cutting. Similar ventilation control innovations helped reduce both work time and personal exposure. 1 ref., 8 figs.

3460 **(DOE/SSDP—0023) Reactor pressure vessel preparation for shipment and burial.** Kea, K.I. Jr. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations). Oct 1987. Contract AC06-76RL01857;AC06-84RL10421. 23p. (CONF-871018—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001861/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the preparation of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) for removal, barge shipment and burial. The preparation of the RPV/NST package results in a monolithic package that more than meets the requirements for a strong-tight container for transport of Low Specific Activity material and is also expected to be adequate for the analysis and scenarios required for a Type B Container. Radiological dose analyses performed on the RPV/NST package for different postulated accident situations demonstrated that radionuclide releases would be insignificant. The description, rationale, engineering considerations and preparation process are described. 10 figs.

3461 **(DOE/SSDP—0024) Establishment of criteria for the unconditional release of the Shippingport Atomic Power Station site.** Eger, K.J.; Giordano, R.J.; Gardner, D.L.; Galgoul, M.J. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations). Oct 1987. Contract AC06-84RL10421;AC06-76RL01857. 17p. (CONF-871018—11). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000609/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the key elements that have led to the specification of the site release criteria for the Shippingport site. The direct recommendation of release limits is discussed as an alternate to basing the limits on a cost benefit basis. However, the paper shows that both the direct recommendation and the cost benefit analysis were important in defining the final release criteria. Finally, the release limits are defined and a proposed plan for implementing them is presented. The work emphasizes the development of a procedure that will consider the cost of postulated remedial actions, and employ an appropriate number of scenarios to demonstrate compliance with applicable limits and the ALARA philosophy. 4 refs., 3 figs., 4 tabs.

3462 **(DOE/SSDP—0025) A summary of lessons learned at the Shippingport Station Decommissioning Project (SSDP).** Crimi, F.P.; Mullee, G.R. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations). Oct 1987. Contract AC06-84RL10421;AC06-76RL01857. 6p. (CONF-871018—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000607/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

This paper describes the lessons learned from a management perspective during decommissioning. The lessons learned are presented in a chronological sequence during the life of the project up to the present time. The careful analysis of the lessons learned and

the implementation of corresponding actions have contributed toward improving the effectiveness of decommissioning as time progresses. The lessons learned should be helpful in planning future decommissioning projects.

3463 **(INIS-mf—10968) Atmospheric diffusion at coastal site in presence of sea-breeze.** Messaci, M. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Mar 1987. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700038/JAW.

The coastal sites present special features so much by the dominant wind system then by the lower layers of the atmosphere. Two types of experiments were handled on a coastal site in presence of sea breeze. First, vertical atmospheric sounding by radiosounding and by throwing experimental balloons; then the discharge of tracer: the SF6. The first experiment lead us to put in a prominent position the Internal Boundary Layer and the determination of its height. Whereas the second experiment allowed us to estimate the diffusion parameters of the site as well as to obtain interesting conclusions on diffusivity of the environment studied and the influence of certain factors.

3464 (INIS-mf—11045, pp 837-850) **Earth science considerations on the storage and disposal of radioactive and used nuclear fuel in Taiwan, ROC.** Soong, K.L. (Institute of Nuclear Energy Research, Atomic Energy Council, Taiwan). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The limited land area, precipitous topography and complex geological structure impose a challenging task in the selection of a storage and disposal site for the radioactive waste and used nuclear fuel in Taiwan, ROC. Particular earth sciences considerations for the site selection in Taiwan should be paid to the following topics: 1. the most demonstrated and tested crystalline rocks, tuffs and salt deposits in some developed countries are not likely to be found favourable for this purpose on this island. We have to look for some less tested rock formations; 2. situated right on the circum-Pacific seismic zone, the island of Taiwan has strong and frequent earthquakes. Tectonic mobility is high; 3. geothermal gradient is normally high and hot springs are wide spread. The changes in the level of ground water are also high in some part of Taiwan; 4. orogenic activity is strong; 5. active volcanoes have not been found, but there are Pleistocene Volcanoes with post-volcanic activities; 6. oil and natural gas evidences are common in the Neogene Sediments; and 7. high CO/sub 2/ activity. In view of the above statements, the following rocks on the island of Taiwan and its offshore islets are considered favourable as candidates for further studies: 1. the thick shale and mudstone formations; 2. the most stable and shallow stratigraphic high of Mesozoic basement close to the western coast; 3. the quartz porphyry islet in the Taiwan Strait; 4. the Eocene quartzite formations and 5. the Mesozoic granitic gneiss of Kinmen island.

3465 **(NRPB-R—205) Calculations of the radiological impact of disposal of unit activity of selected radionuclides.** Smith, G.M.; Fearn, H.S.; Delow, C.E.; Lawson, G.; Davis, J.P. (National Radiological Protection Board, Chilton (UK)). Mar 1987. 70p. H.M. Stationery Office, London, price Pound 6.00.

The purpose of the work described is to provide estimates of the radiological impact following disposal of unit activity via each of several options, including disposal on the deep ocean bed, shallow burial, engineered trench disposal, disposal in a geologic repository and disposal in off-shore boreholes. Results are presented for a range of important representative radionuclides (^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{99}Tc, ^{106}Ru, ^{129}I, ^{137}Cs, ^{237}N, ^{238}U, ^{239}Pu, ^{241}Pu, ^{241}Am). These results may be used in conjunction with waste inventory data to obtain a preliminary view of the relative radiological merits of various disposal options. In the course of the calculations it was necessary to make a number of simplifying assumptions. The implications of these are discussed in the context of use of the results for comparative assessments of systems of waste management

3466 **(NUREG/CR—3320-Vol.3) LWR [Light Water Reactor] Pressure Vessel Surveillance Dosimetry Improvement Program: PSF Physics-Dosimetry Program.** McElroy, W.N.; Gold, R. (eds.). (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76FF02170. 322p. (HEDL-TME—87-3). NTIS, PC A14/MF A01 - GPO. Order Number DE88001716/JAW.

The metallurgical irradiation experiment at the Oak Ridge Research Reactor Poolside Facility (ORR-PSF) is one of the series of benchmark experiments in the framework of the Light Water Reactor Pressure Vessel Surveillance Dosimetry Improvement Program (LWR-PV-SDIP). The goal of this program is to test, against well-established benchmarks, the methodologies and data bases that are used to predict the irradiation embrittlement and fracture toughness of pressure vessel and support structure steels. The prediction methodology includes procedures for neutron physics calculations, dosimetry and spectrum adjustment methods, metallurgical tests, and damage correlations. The benchmark experiments serve to validate, improve, and standardize these procedures. The results of this program are implemented in a set of ASTM Standards on pressure vessel surveillance procedures. These, in turn, may be used as guides for the nuclear industry and for the Nuclear Regulatory Commission (NRC). To serve as a benchmark, a very careful characterization of the ORR-PSF experiment is necessary, both in terms of neutron flux-fluence spectra and of metallurgical test results. Statistically determined uncertainties must be given in terms of variances and covariances to make comparisons between predictions and experimental results meaningful. Detailed descriptions of the PSF physics-dosimetry program and its results are reported.

3467 **(SKB-TR—86-10) Fissure fillings from the Klipperaas study site.** Tullborg, E.L. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jul 1986. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753365/JAW.

The Klipperaas study site is located within the Smaaland-Vaermland granitoid belt in southern Sweden. The area investigated can be subdivided into blocks with different hydraulic character and fracture frequency of the rocks. A fissure filling, study has been carried out within the area. This includes identification of the minerals, mineral frequency, textures within the fissures and isotope analyses of calcites. Four generation of fissure fillings, within the time space c. 1600 M.a. to present, has been distinguished. These are 1) quartz; 2) epidote + muscovite and adularia + hematite; 3) calcite + chlorite +/hematite; 4) calcite, clay minerals and Fe-oxyhydroxide. It is observed that the surface water affect the uppermost part of the bedrock resulting in calcite dissolution, break down of pyrite and precipitation of Fe-oxyhydroxide. It is also obvious from the fracture calcite frequency that calcite dissolution is more intensive close to and within the fracture zones. There, Fe-oxyhydroxide can be found down to at least 400 m depth. This gives valuable information about the physic-chemical character of the groundwater within the bedrock. Several fracture zones have been reactivated. It is also suspected that relatively late movements have taken place causing crushing of the rock and only a slight cementation of the crushed material is visible. Some of the fracture zones correspond to mafic dikes. These zones exhibit lower hydraulic conductivity than other zones due to fracture sealing by clay minerals but also by chlorite and calcite.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 3451, 3466, 3488, 3519, 3520, 3521, 3522, 3523, 3524

3468 **(AAEC/E—646) Theoretical models to predict the transient heat transfer performance of HIFAR fuel elements under non-forced convective conditions.** Green, W.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700287/JAW.

Simple theoretical models have been developed which are suitable for predicting the thermal responses of irradiated research fuel elements of markedly different geometries when they are subjected to loss-of-coolant accident conditions. These models have

been used to calculate temperature responses corresponding to various non-forced convective conditions. Comparisons between experimentally observed temperatures and calculated values have shown that a suitable value for surface thermal emissivity is 0.35; modelling of the fuel element beyond the region of the fuel plate needs to be included since these areas account for approximately 25 per cent of the thermal power dissipated; general agreement between calculated and experimental temperatures for both transient and steady-state conditions is good - the maximum discrepancy between calculated and experimental temperatures for a HIFAR Mark IV/V fuel element is ~ 70 deg C, and for an Oak Ridge Reactor (ORR) box-type fuel element ~ 30 deg C; and axial power distribution does not significantly affect thermal responses for the conditions investigated. Overall, the comparisons have shown that the models evolved can reproduce experimental data to a level of accuracy that provides confidence in the modelling technique and the postulated heat dissipation mechanisms, and that these models can be used to predict thermal responses of fuel elements in accident conditions that are not easily investigated experimentally.

3469 (AAEC/E—652) Condensation of steam on the external surfaces of the shells of HIFAR heavy water heat exchangers during a loss-of-coolant accident. Chapman, A.G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700291/JAW.

A study of steam condensation rates on the HIFAR heavy water heat exchangers was undertaken to predict thermohydraulic conditions in the HIFAR containment during a postulated loss-of-coolant accident (LOCA). The process of surface condensation from a mixture of air and steam, and methods for calculating the rate of condensation, are briefly reviewed. Suitable experimental data are used to estimate coefficients of condensation heat transfer to cool surfaces in a reactor containment during a LOCA. The relevance of the available data to a LOCA in the HIFAR materials testing reactor is examined, and two sets of data are compared. The differences between air/H/sub 2/O and air/D/sub 2/O mixtures are discussed. Formulae are derived for the estimation of the coefficient of heat transfer from the heat exchanger shells to the cooling water, and a method of calculating the rate of condensation per unit area of surface is developed.

3470 (HEDL-SA—3645) Thermal analysis of lithium cooled natural circulation loop module for fuel rod testing in the Fast Flux Test Facility. Eyler, L.L.; Kim, D.; Stover, R.L.; Beaver, T.R. (Hanford Engineering Development Lab., Richland, WA (USA); Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76FF02170. 31p. (PNL-SA—14511; CONF-871207—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87009973/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Maximum heat removal capability of a lithium cooled natural circulation fuel rod test module design is determined. Loop geometry is optimized within limitations of design specifications for nominal operation temperatures, materials, and test module environment. Results provide test module operation limits and range of potential uncertainties. 3 refs., 12 figs.

3471 (INIS-BR—880) Experience acquired with the IPR-R1 reactor as a research and development tool. Maretti Junior, F.; Stasiulevicius, R. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 1p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700414/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

Published in summary form only.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 3474

2209 Reactor Safety

REFER ALSO TO CITATION(S) 3164, 3546, 4234, 4418, 4525, 5300

3472 (BNL-NUREG—40207) Overview, what is ALARA? Are we there?. Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-871202—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014919/JAW.

From 21. mid-year meeting of the Health Physics Society: power reactor health physics; Miami Beach, FL, USA (12 Dec 1987).

As low as reasonably achievable (ALARA) in radiation protection at nuclear power plants is a complex criterion involving decisions requiring both professional judgement and quantitation. Professional judgement has been emphasized in most plants to date. However, unless quantitative studies are made it will be difficult to judge if doses at US plants are ALARA. An ALARA assessment for each plant is suggested, which would include evaluations of both qualitative, e.g., organizational, and quantitative, e.g., cost-benefit or cost-effectiveness, efforts. 15 refs., 4 tabs.

3473 (CEA-DAS—349) Pressurized water reactor safety approach and analysis. From conception to experience feedback. Libmann, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Apr 1987. 282p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750258/JAW.

This report deals in ten chapters, with the following subjects: 1. Safety approach methods; 2. Study of accidents; 3. Safety analysis; 4. Study of internal aggressions or those involved by the site; 5. Consideration of complementary situations; 6. Three Mile Island accident; 7. Safety during operation and experience feedback; 8. An example of analysis: steam generator closure plug; 9. Probabilistic safety evaluation; 10. Chernobyl accident. 30 refs.

3474 (CEA-IPSN-INFO—68) Water leak from the main pool of Siloe reactor. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Mar 1987. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750272/JAW.

Published in summary form only.

3475 (EGG-M—02186) Preparations to load, transport, receive, and store the damaged TMI-2 [Three Mile Island] reactor core. Reno, H.W.; Schmitt, R.C.; Quinn, G.J.; Ayers, A.L. Jr.; Lilburn, B.J. Jr.; Uhl, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1986. Contract AC07-76ID01570. 36p. (CONF-860317—61). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001505/JAW.

From Waste management '86; Tucson, AZ, USA (2 Mar 1986).

The March 1979 incident at the Three Mile Island Nuclear Power Station (TMI) which damaged the core of the Unit 2 reactor resulted in numerous scientific and technical challenges. Some of those challenges involve removing, packaging, and transporting the core debris to the Idaho National Engineering Laboratory (INEL) for storage, examination, and preparation for final disposal. This paper highlights preparations for transporting the core debris from TMI to INEL and receiving and storing that material at INEL. Issues discussed include interfacing of equipment and facilities at TMI, loading operations, transportation activities using a newly designed cask, receiving and storing operations at INEL, and criticality control during storage. Key to the transportation effort was designing, testing, fabricating, and licensing two rail casks which individually provide double containment of the damaged fuel. 27 figs.

3476 **(EGG-M—08986) TMI-2 core boring machine.** Croft, K.M.; Helbert, H.J.; Laney, W.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1986. Contract AC07-76ID01570. 7p. (CONF-860724—15). NTIS, PC A02. Order Number DE88001574/JAW.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

An important and essential aspect of the TMI-2 defueling effort is to determine what occurred in the core region during the accident. Remote cameras and probes only portray a portion of the overall picture. What lies beneath the rubble bed and solidified sublayer is, as yet, unknown. This paper discusses the TMI-2 Core Boring Machine, which has been developed to drill into the damaged core of the TMI-2 reactor and extract stratified samples of the core. This machine, its unique support structure, positioning and leveling systems, and specially designed drill bits, combine to provide a unique mechanical system. in addition, the machine is controlled by a micro-processor, which actually controls the drilling operation, allowing relatively inexperienced operators to drill the core samples. A data acquisition system is integral with the controlling system and collects data relative to system conditions and monitored parameters during drilling. Data obtained during the actual drilling operations are collected in a data base which will be used for actual mapping of the core region, identifying materials and stratification levels that are present. Ultimately, this information will be used during the overall defueling of the reactor.

3477 **(EGG-M—18087) The TMI-2 accident: Scenario and impact.** Broughton, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 65p. (CONF-8707121—1-Vugraphs). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001533/JAW.

From MIT safetycourse; Cambridge, MA, USA (10 Jul 1987).

The objectives of this report were to analyze the Three Mile Island-2 reactor accident, postulate a scenario, and to utilize the results to aid in resolving uncertainties related to core damage progression, steam explosions, and fission product release and transport. (FI)

3478 **(EGG-M—21386) Nuclear Plant Analyzer development at the Idaho National Engineering Laboratory.** Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1986. Contract AC07-76ID01570. 4p. (CONF-8610135—64). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001576/JAW.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Nuclear Plant Analyzer (NPA) is a state-of-the-art safety analysis and engineering tool being used to address key nuclear power plant safety issues. Under the sponsorship of the US Nuclear Regulatory Commission (NRC), the NPA has been developed to integrate the NRC's computerized reactor behavior simulation codes such as RELAP5, TRAC-BWR and TRAC-PWR, with well-developed computer color graphics programs and large repositories of reactor design and experimental data. An important feature of the NPA is the capability to allow an analyst to redirect a RELAP5 or TRAC calculation as it progresses through its simulated scenario. The analyst can have the same power plant control capabilities as the operator of an actual plant. The NPA resides on the dual Control Data Corporation Cyber 176 mainframe computers at the Idaho National Engineering Laboratory and Cray-1S computers at the Los Alamos National Laboratory (LANL) and Kirtland Air Force Weapons Laboratory (KAFWL).

3479 **(EGG-M—24987) Evaluation of human error estimation for nuclear power plants.** Haney, L.N.; Blackman, H.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-8708159—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001592/JAW.

From 95. annual convention of the American Psychological Association; New York City, NY, USA (31 Aug 1987).

The dominant risk for severe accident occurrence in nuclear power plants (NPPs) is human error. The US Nuclear Regulatory Commission (NRC) sponsored an evaluation of Human Reliability Analysis (HRA) techniques for estimation of human error in NPPs. Twenty HRA techniques identified by a literature search were evaluated with criteria sets designed for that purpose and categorized. Data were collected at a commercial NPP with operators responding in walkthroughs of four severe accident scenarios and full scope simulator runs. Results suggest a need for refinement and validation of the techniques. 19 refs.

3480 **(EGG-M—27786) Insights on severe accident chemistry from TMI-2 .** Hobbins, R.R.; Cronenberg, A.W.; Langer, S.; Owen, D.E.; Akers, D.W. (EG and G Idaho, Inc., Idaho Falls (USA); ESA, Inc., Idaho Falls, ID (USA); Owen (D.E.), Hummelstown, PA (USA)). 1986. Contract AC07-76ID01570. 20p. (CONF-860911—30). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001499/JAW.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

Chemical analyses are being carried out on materials removed from the damaged reactor at TMI-2. Characteristics of TMI-2 fuel, control, fission product and structural materials based on these analyses are presented. Emphasis is placed on chemistry within the pressure vessel although descriptions of, and postulated mechanisms for, materials transported from the vessel to the reactor building are also discussed. Indications of the oxygen potential in the reactor pressure vessel during the high temperature phase of the accident are of particular significance for the analysis of damage progression and fission product behavior during severe accidents. The results of thermodynamic and kinetic calculations for chemical species present during the high temperature portion of the accident (during core uncovery) are presented. Insights on chemistry of significance for severe accident analysis which follow from the evaluation of the TMI-2 accident are discussed. 38 refs., 9 figs., 2 tabs.

3481 **(EGG-M—29686) Results of USNRC research on fuel rod behavior during LOCAs [loss of coolant accidents].** Siefken, L.J.; Allison, C.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 19p. (CONF-8609344—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001537/JAW.

From OECD meeting on fuel rod behavior; Cadarche, France (11 Sep 1986).

The understanding of fuel rod behavior during large break loss of coolant accidents (LOCAs) is much more complete now than in January 1974 when licensing criteria were promulgated in 10 Code of Federal Register (CFR) Part 50. This paper presents the results of research sponsored by the United States Nuclear Regulatory Commission that has contributed to this improved understanding of fuel rod behavior. Since the USNRC believes that safety is best served when decisions are based on realistic calculations, the paper also summarizes the possible impact of research results on licensing criteria.

3482 **(EGG-RTH—7285-Vol.2) Encounter: NRC/DRPS Reactor Safety Data Bank.** (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1987. Contract AC07-76ID01570. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001536/JAW.

3483 **(EGG-TMI—7843) TMI-2 data summary report.** McCormick, R.D.; Anderson, J.L.; Golden, D.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 325p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88002204/JAW.

This report presents all the qualified data generated during the performance of the Data Review Task as part of the TMI-2 Accident Evaluation Program. Data are in graphic form accompanied by amplitude and time base uncertainties. The main body of the report contains the data plots, definition of terms, and a brief description of the data review process. There is also a table summarizing the data qualification categories and uncertainties. Appendices give details on how the data review was performed, data sources, details of analysis methodology, and letter reports generated during the task as reference material.

3484 **(EGG-TMI—7844) Summary of TMI-2 data bases.** Brower, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002205/JAW.

This report summarizes seven major data base products produced by the Data Reduction and qualification Section of the TMI-2 Accident Evaluation Program. The purpose and a brief description of data base structure are presented in the introductory section, together with rational involved in selection of data base media. Major emphasis in the report is placed in more detailed examinations of four personal computer data bases which utilize an INEL developed data base management system, SAGE. Content of each data base is described, the current development status is defined and future activity associated with each dynamic structures is outlined.

3485 **(EUR—6539) Heat loss tests for the LOBI-MOD2 facility.** Sanders, J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750501/JAW.

The results and analysis of the LOBI-MOD2 heat loss tests are presented in this report. The facility heat losses are evaluated at constant temperature from power balance and for a whole temperature range by a transient method. Heat losses of the individual loop components are determined by a combination of measurements and heat conduction calculations.

3486 **(EUR—10782) External and internal accidents in PWR power plants. Comparison of current regulations in Belgium, United States, France, Federal Republic of Germany and United Kingdom.** Maere, G. de; Roch, M.; Cavaco, A.; Preat, M. (Belgatom, Brussels, Belgium). (Commission of the European Communities, Luxembourg). 1986. 196p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750661/JAW.

In this report a comparison is made of the rules and practices applied in various countries (Belgium, France, Federal Republic of Germany, United Kingdom and United States of America) in designing PWR plants to resist natural hazards (first part of the report) and hazards associated with human activities (second part). The third part of the report deals with the practices in different countries concerning the protection against accidents of internal origin.

3487 **(GAO/RCED—86-132) Nuclear Energy: Compendium of relevant GAO products on regulation, health, and safety.** (General Accounting Office, Washington, DC (USA)). 1986. 49p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report presents findings, conclusions, and recommendations in the areas of (1) protecting worker health and safety, (2) planning for nuclear emergencies and coordinating response mechanisms in the event of a serious nuclear accident, (3) ensuring the safe design of facilities, and (4) monitoring the environment. GAO points out that impaired organizational independence of the oversight function, a lack of headquarters authority, and the decentralized nature of the oversight activities may constitute serious problems over the long term. More recent GAO work indicates that organizational independence of the oversight function may still be a problem area and is likely to receive increased scrutiny in the aftermath of the Chernobyl nuclear reactor accident in the Soviet Union.

3488 **(HEDL-SA—3652) The role of natural circulation in the FFTF [Fast Flux Test Facility] passive safety tests.** Stover, R.L.; Padilla, A.; Burke, T.M.; Knecht, W.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76FF02170. 28p. (CONF-871207—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87010717/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

A series of tests were completed at the Fast Flux Test Facility to demonstrate the passive safety characteristics of liquid metal reactors with natural circulation flow. The first test consisted of transition from forced to natural circulation flow at an initial decay power of 0.3%. The second test represented an unprotected loss-of-flow transient to natural circulation from 50% power with the control rods prevented from scramming into the core. The third test was a steady-state, natural circulation condition with core fission powers up ato about 2.3%. Core sodium data and results of single and multi-channel computer models confirmed the reliability and effectiveness of natural circulation flow for liquid metal reactor safety.

3489 **(IAEA-TECDOC—425) Simulation of a loss of coolant accident. Results of a standard problem exercise on the simulation of a loss of coolant accident.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 305p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88700362/JAW.

An essential component of nuclear safety activities is the analysis of postulated accidents which are taken as a design basis for a facility. This analysis is usually carried out by using complex computer codes to simulate the behaviour of the plant and to calculate vital plant parameters, which are then compared with the design limits. Since these simulations cannot be verified at the plant itself, computer codes must be validated by comparing the results of calculations with experimental data obtained in test facilities. With this objective in mind, the Central Research Institute for Physics (CRIP) of the Hungarian Academy of Sciences designed and constructed the PMK-NVH (Paks Model Circuit) test facility, a scaled down model of the WWER-440 Paks nuclear power plant. Hungary with the aim of strengthening the international co-operation on nuclear safety, made the PMK-NVH facility available to the IAEA to conduct a standard problem exercise. In this exercise, experimental data from the simulation of a 7.4% break loss of coolant accident were compared with analytical predictions of the behaviour of the facility calculated with computer codes. This document presents a complete overview of the Standard Problem Exercise, including description of the facility, the experiment, the codes and models used by the participants and a detailed intercomparison of calculated and experimental results. It is recognized that code assessment is a long process which involves many inter-related steps, therefore, no general conclusion on optimum code or best model was reached. However, the exercise was recognized as an important contributor to code validation. Refs, figs and tabs.

3490 **(IMFUFA—133) Chernobyl accident: Assessing the data.** Soerensen, B. (Roskilde Universitetscenter (Denmark). Inst. for Studiet af Matematik og Fysik samt deres Funktioner i Udervisning, Forsning og Anvendelser). 1986. 13p. Roskilde Universitetscenter, DK-4000 Roskilde.

Data presented in the official Soviet report to the IAEA on the Chernobyl reactor accident are critically assessed. Special attention is given to the derivation of release fractions from fallout measurements, a procedure which is demonstrated to involve large elements of uncertainty. Further comments relate to estimates of plume rise and deposition velocity. A comparison is made with the predictions of previously published theoretical reactor safety studies.

3491 **(INIS-BR—882) Analysis of a loss-of-coolant accident for Angra-2 reactor using the Relap 5/Mod 1 computer code.** Lavorato, W.R.A.; Figueiredo, M.E.; Arone, I.D. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 10p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700416/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

The RELAP5/MOD1 computer code was used in the analysis of a loss coolant accident (LOCA), postulated for Angra-2. The power plant was simulated through a division in control volumes and junctions suitable for a small break accident calculation. Initially a steady state of 100s was calculated. After these first 100s, a 100cm/sup 2/ cold leg small break accident, between the main coolant pump and the reactor pressure vessel, was calculated. The results showed the efficiency of the safety injection system to

remove the residual heat and to maintain the reactor core covered by a two phase mixture.

3492 **(INIS-BR—883) Reactor limitation system improves the safety and availability of the Angra 2 nuclear power plant.** Souza Mendes, J.E. de. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1987. 9p. (In Portuguese). (CONF-8708169—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700417/JAW.

From 4. Brazilian Congress of Energy; Rio de Janeiro, Brazil (17 Aug 1987).

Beyond the classic Reactor Protection System and Reactor Control System, nuclear plant Angra 2 has a third system called Reactor Limitation System which combines the intelligence features of the control systems with the high reliability of the protection systems. In determined events, which are not controlled by the control system (e.g.: load rejection, failure of one main reactor coolant pump), the Reactor Limitation System actuates automatically in order to lead the plant to a safe operating condition and so it avoids the actuation of the Reactor Protection System and consequently the reactor trip. This increases safety and availability of the plant and reduces component stresses. After the safe operating condition is reached, the process guidance automatically returns to the control systems.

3493 (INIS-mf—10730, pp 45-46) **Stock-taking of I-129 in human thyroids.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

8 human thyroids were examined for I-129 and I-127 throughout the first four months after the Chernobyl accident. I-129 concentrations ranged between 7 and 60 μBq/g FW, thus being within the variation range of the values determined throughout recent years. The I-129-to-I-127 isotope ratio fluctuated between 4x10/sup -9/ and 3.5x10/sup -8/.

3494 (INIS-mf—10730, pp 47-62) **Additional investigations within the research programme launched after the Chernobyl accident.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The additional investigations concern the determination of the transfer of the fission products I-131, Cs-137, Cs-134, and Te-132 along the pasture-cattle-milk pathway insolving fresh grass, and of the fission products Cs-137 and Cs-134 from winter fodder to milk, beef and veal, and the enrichment of Cs-137 and Sr-90 in the human organism as well as the migration of the fission products Cs-137, Cs-134, Ru-103, and K-40 from the Chernobyl fall-out to the soil.

3495 (INIS-mf—10730, pp 105-115) **Investigations into special radio-ecological issues.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

Following the Chernobyl accident, a stock-taking of the radioactivity in environmental and food samples was launched involving nuclide-specific analysis and studies on washout by snow. Under the heading of investigations into special radio-ecological issues, studies were performed to determine the up-take quantity of externally applied radionuclides by spruce; the isotopes were I-125, Ca-45, and Cs-134 applied as aqueous solutions.

3496 (INIS-mf—11045, pp 1019-1033) **Engineering input parameters for the seismic design of nuclear facilities in Southern Africa.** Wium, D.J.W.; Opperman, G.H.P. (Van Wyk and Louw Inc., Pretoria, South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Appropriate parameters need to be provided for the seismic design of safety related structures, systems and components. A probability based methodology is described for defining such input for sites in Southern Africa. First, the general approach is briefly explained, after which models for the occurrence of earthquakes in this region are developed. Attenuation functions which express the diminishing effects of earthquake motion in Southern Africa are also proposed. The developed method is then used to predict design response spectra for various return periods for a typical site. These can then be used for the design of structures at that location for any particular level of risk.

3497 (INIS-mf—11045, pp 615-634) **Radioactive fall-out from the Chernobyl disaster, and its aftermath in Central Europe.** Mueller-Broich, A. (Regensburg Univ., Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Radioactive fall-out originating from the disaster of the nuclear power station at Chernobyl in the Soviet Union was measured in Bavaria and other parts of Central Europe. Nuclide composition and spatial distribution of fall-out are presented and compared to radioactive debris from nuclear bomb tests. The uptake of radioactive material by plants and its passage into human food is discussed. The contribution of direct deposition, redistribution within plants and transfer from soil into plants is considered. Factors determining the paths of radioactive material into milk and meat are outlined. Safety precautions against excessive incorporation of radioactivity issued by the authorities are given. Irradiation of humans from external and internal fall-out is assessed. Nuclides composition is shown to be of major importance only for internal radiation. In view of the dominating abundance of radioiodine and radiocesium the differing physical and biochemical qualities of these nuclides are described in more detail. Finally, the resulting risk of cancer induction including leukemia is considered.

3498 **(INIS-XN—63) 28 April 1986: Royal Order determining the certificate of financial security for the carriage of nuclear substances.** (International Atomic Energy Agency, Vienna (Austria)). 16 May 1986. 2p. (In French and Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700043/JAW.

Published in Moniteur belge.

The purpose of this Royal Order is to ensure that financial security certificates given by the nuclear operators liable to carriers of nuclear substances conform to the conditions set out in Article 4(c) of the Paris Convention on Third Party Liability in the field of Nuclear Energy. This is a requirement under the Belgian Act of 22nd July 1985 on Third Party Liability in the field of Nuclear Energy. The Annex to the Order contains a model certificate reproducing the type of information required in accordance with the Paris Convention.

3499 **(INIS-XN—66) Act No. 388 to amend Section 15 of the Nuclear Liability Act.** (International Atomic Energy Agency, Vienna (Austria)). 23 May 1986. 1p. (In Finnish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700046/JAW.

Finland is ratifying the Montreal Protocols Nos. 3 and 4 to the Warsaw Convention concerning carriage by air; protocol No. 4 contains no exclusion clause for nuclear damage. This Act amends the 1972 Nuclear Liability Act to the effect that air carriers of nuclear substances have a right of recourse against the operator liable under nuclear legislation. In this way the principle of channelling liability onto the nuclear operator is maintained. (NEA).

3500 **(INIS-XN—67) Air Carriage Act No. 387.** (International Atomic Energy Agency, Vienna (Austria)). 23 May 1986. 7p. (In Finnish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700047/JAW.

This new Act enables Finland to ratify Protocols 3 and 4 to the Warsaw Convention concerning international carriage by air. It also concerns transport of radioactive materials. (NEA).

3501 **(INIS-XN—76) Order on nuclear third party liability (ORCN) Amendment of 2 December 1985.** (International Atomic Energy Agency, Vienna (Austria)). 2 Dec 1985. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700054/JAW.

According to the 1983 Act on Nuclear Third Party Liability the Federal Council must increase the minimum amount of three hundred million francs covered by private insurance when the insurance market offers a higher coverage at acceptable conditions. The Swiss insurers being in a position to cover the sum of four hundred million francs as from January 1986, the Government accordingly amended the Ordinance of 5th December 1983 on Nuclear Third Party Liability (ORCN). The Confederation continues to act as an insurer for the difference between this amount and one thousand million francs; contributions due in this respect will be reduced to take account of the greater sum to be covered by private insurance. The New Ordinance entered into force on 1st January 1986. (NEA).

3502 (IWGFR—62, pp 164-170) **Dynamic characteristics of heterogeneous media in vibrational and wave processes.** Fedotovskij, V.S.; Sinyavskij, V.F.; Terenik, L.V.; Spirov, V.S.; Kokorev, B.V. Oct 1986. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700461/JAW. (CONF-8610225—).

From International Atomic Energy Agency IWGFR specialists meeting on flow induced vibrations; Paris, France (21 Oct 1986).

The complex mechanic systems involving a great quantity of the same type elements, in particular, the rod systems flowed around by the one- or two-phase flow are considered as the two- or three-phase heterogeneous media with certain effective properties. Some recommendations for calculating effective properties and determining those on a base of the dynamic characteristics of various heterogeneous systems are given. 8 refs, 3 figs.

3503 **(LA-UR—87-2074) Reverse primary-side flow in steam generators during natural circulation cooling.** Stumpf, H.; Motley, F.; Schultz, R.; Chapman, J.; Kukita, Y. (Los Alamos National Lab., NM (USA); EG and G Idaho, Inc., Idaho Falls (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki). 1987. Contract W-7405-ENG-36. 8p. (CONF-871207—7). NTIS, PC A02. Order Number DE87011768/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

A TRAC model of the Large Scale Test Facility with a 3-tube steam-generator model was used to analyze natural-circulation test ST-NC-02. For the steady state at 100% primary mass inventory, TRAC was in excellent agreement with the natural-circulation flow rate, the temperature distribution in the steam-generator tubes, and the temperature drop from the hot leg to the steam-generator inlet plenum. TRAC also predicted reverse flow in the long tubes. At reduced primary mass inventories, TRAC predicted the three natural-circulation flow regimes: single phase, two phase, and reflux condensation. TRAC did not predict the cyclic fill-and-dump phenomenon seen briefly in the test. TRAC overpredicted the two-phase natural-circulation flow rate. Since the core is well cooled at this time, the result is conservative. An important result of the analysis is that TRAC was able to predict the core dryout and heatup at approximately the same primary mass inventory as in the test. 4 refs., 8 figs., 2 tabs.

3504 **(NEI-NO—27) Chernobyl reactor accident. Atmospheric transport and dispersal of radioactive substance.** Saltbones, J. (Norske Meteorologiske Inst., Oslo). 1986. 115p. (In Norwegian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753036/JAW.

The weather situation over Europe during the first days after the Chernobyl accident is described, and an estimation of the plume rise and the transport level of the emission from the reactor is given. The main characteristics of the radioactive cloud towards Norway are shown on trajectory maps. Maps showing the precipitation pattern in Norway during the relevant time period are also presented.

3505 **(NIRS-M—61) Radiological survey for the tourists in USSR around the Chernobyl accident.** (National Inst. of Radiological Sciences, Chiba (Japan)). Aug 1986. 83p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700063/JAW.

In connection with the accident of the Chernobylsk-4 reactor in the USSR on April 26 1986, the National Institute of Radiological Sciences, Japan, carried out medical examinations on May 5 in all of the 118 tourists returning from Kiev, a town 150 km south of Chernobyl. The report gives the results of radiological survey. Surface contamination of radioisotopes was detected in 55 (47%) persons. For 43 (36%) persons, blood and urinary examinations were required. The most frequent site of radioactivity detection was hair (40%), followed by the thyroid gland and shoulders of their coats (18%). The maximum radioactivity was 2,500 cpm in the hair, 0.028 mR/h in the thyroid gland, 0.02 mR/h in the nose, and 3,000 cpm in the shoulders of the coat. Surface cleaning was necessary in 15 persons. There was a distinct difference in radioactivity of the hair between the persons who washed their hairs and the persons who did not. In 17 (14%) persons in whom radioactivity on the surface of the body and in the thyroid gland was high, urinary excretion of iodine-131 was seen. The maximum radioactivity was 4,100 pCi/l. Blood level of radioactivity was 20 pCi or less. For 18 nasal smears, radioactivity was undetectable. Results for other 100 volunteers coming back from European countries are also given. There are no data suggesting potential health hazards. (Namekawa, K.).

3506 **(NUREG—0896-Suppl.7) Safety evaluation report related to the operation of Seabrook Station, Units 1 and 2 (Docket Nos. 50-443 and 50-444).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1987. 73p. NTIS, PC A04/MF A01 - GPO. Order Number DE88900110/JAW.

This report is Supplement No. 7 to the Safety Evaluation Report (NUREG-0896, March 1983) for the application filed by the Public Service Company of New Hampshire, et al. for licenses to operate Seabrook Station, Units 1 and 2 (Docket Nos. STN 50-443 and STN 50-444). It has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission and provides recent information on open items identified in the SER. The facility is located in Seabrook, New Hampshire. Subject to favorable resolution of the items discussed in this report, the staff concludes that the facility can be operated by the applicant without endangering the health and safety of the public.

3507 **(NUREG/CR—4727) SWISS: Sustained heated metallic melt/concrete interactions with overlying water pools.** Blose, R.E.; Gronager, J.E.; Suo-Anttila, A.J.; Brockmann, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 267p. (SAND—85-1546). NTIS, PC A12/MF A01 - GPO. Order Number TI88002064/JAW.

Results of the test SWISS-1 and test SWISS-2 are reported. These tests examined the effects of an overlying water pool on high temperature melt interactions with concrete. In both tests, a melt of about 46 kilograms of type 304 stainless steel was formed and deposited onto a 21.6 cm diameter disk of limestone/common sand concrete. The concrete disk was retained within a cast MgO annulus. The molten steel was sustained at a power input of 1.3 to 1.7 Watts/gram by induction heating. In test SWISS-1 a water pool was formed over the melt after about 12 cm of concrete had eroded. In test SWISS-2, the water pool was formed about one minute after melt contacted the concrete and before any significant erosion of concrete could take place. In both tests the water pool was kept below the boiling point. Interactions were sustained for about 40 minutes in the two tests. Concrete erosion rates, concrete temperatures, heat fluxes to the overlying water pool, gas generation rates, and evolved gas compositions during tests SWISS-1 and SWISS-2 are reported. Aerosol generation rates are reported for test SWISS-2. 46 refs., 70 figs., 26 tabs.

3508 **(NUREG/CR—4941) The application of value-impact analysis to USI A-45: Summary report of UCLA studies on value-impact analysis in relation to USI A-45.** Cave, L.; Kastenberg, W.E. (California Univ., Los Angeles (USA). School of Engineering and Applied Science; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Sep 1987. Contract AC04-76DP00789. 220p. (SAND—87-7116). NTIS, PC A10/MF A01 - GPO. Order Number DE88002163/JAW.

In the Task Action Plan for Unresolved Safety Issue A-45 (After-Heat Removal) it was recognized that the value-impact (VI) analysis of possible solutions would be an essential part of the work, particularly in the later stages. Accordingly, a review of existing methods and development of a methodology to meet the specific requirements of TAP A-45 was undertaken. In this report each of the principal areas of work is described. Due to the high capital costs associated with major changes to DHR systems, values arising from avertable "offsite costs" (i.e., the costs of the potential effects on the health and safety of the public, both direct and indirect) would be insufficient to justify any significant changes to DHR systems simply on the grounds of cost effectiveness. Therefore, a major part of the work reported here has been a study of possible additional avertable costs that should properly be included in the "value" term of the V-I analysis.

3509 **(NUREG/CR—4942) Equipment operability during station blackout events.** Jacobus, M.J.; Nicolette, V.F.; Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Oct 1987. Contract AC04-76DP00789. 47p. (SAND—87-0750). NTIS, PC A03/MF A01 - GPO. Order Number DE88001644/JAW.

This report is an initial look at a possible analysis method for determining if equipment expected to operate during and after a station blackout can be "reasonably" expected to survive the environments generated. The dominant environment in this scenario is expected to be dry heat, and this is the only one explicitly analyzed in this report. The general conclusion is that a simple analysis method such as the one presented herein can be used to assess equipment operability in station blackout environments.

3510 **(NUREG/CR—4988) A TRAC-PF1/MOD1 analysis of the Ginna tube-rupture event on January 25, 1982.** Lime, J.F.; Jenks, R.P. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Oct 1987. Contract W-7405-ENG-36. 56p. (LA—11094). NTIS, PC A04/MF A01 - GPO. Order Number DE88001664/JAW.

The R.E. Ginna steam-generator tube-rupture (SGTR) event on January 25, 1982, was simulated using the Transient Reactor Analysis Code TRAC-PF1/MOD1, version 12.3. A complete TRAC model of the Ginna plant was developed, and the SGTR event was calculated to 5000 s. The overall plant behavior was simulated, with excellent to reasonable agreement obtained between calculated results and measured data. A primary objective of calculating and matching the actual reactor trip time was achieved. The analysis demonstrates that TRAC can accurately simulate full-scale plant SGTR transients.

3511 **(PNL-SA—15019) Managing hazards and evaluating safety in nuclear facilities.** Russcher, G.E. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 8p. (CONF-870820—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000091/JAW.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

Potential hazards associated with operating a nuclear facility were used to appraise the safety system of the facility. A list of credible hazards representing potential energy sources was developed through use of a preliminary hazard analysis. Using a weighted selection process, a team of technical and management staff members reduced the list to a manageable number of postulated accident scenarios for in-depth evaluation during a facility safety appraisal. The resultant facility appraisal reviewed six major functional areas of the facility's safety system to determine whether it was effectively controlling the hazards or precluding the postulated accidents. 11 refs., 1 fig.

3512 **(SAND—87-1898C) Improvements to the original NUREG-1150 accident sequence analyses.** Cramond, W.R.; Camp, A.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8710111—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001653/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Since the accident sequence analyses to support the draft NUREG-1150 were published (NUREG/CR-4550), comments have been received from the utilities, the Nuclear Regulatory Commission, the nuclear industry, and the public. It is the intent to incorporate comments to the extent possible, along with anticipated changes produced by the analysis teams. The purpose of this paper is to identify the important comments and issues that will be addressed for each plant during the reanalysis. There are a few general changes in the methodology that apply to all of the plants. The most important change is an improved uncertainty analysis, including a more comprehensive treatment of uncertainty issues and a more defensible approach to eliciting expert opinion on these issues. Another important change is the addition of external events to the analysis of the Surry and Peach Bottom plants. These and other changes are discussed in this paper. 8 refs.

3513 **(SAND—87-2064C) The level 3 probabilistic risk assessment of LaSalle Unit 2.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-8710111—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002109/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Under contract to the US Nuclear Regulatory Commission, Sandia National Laboratories (SNL) is performing a state-of-the-art Level 3 Probabilistic Risk Analysis of LaSalle Unit 2, a BWR5 with a Mark II containment. Results obtained to data from the Level 1 internal, fire, flood, and seismic analyses indicate the characteristics of dominant accident sequences and reveal distinct advantages to the integrated systems-analysis approach being employed. The extension of an integrated methodology to the accident progression, source term and consequence analyses will permit a quantitative treatment of uncertainties in Level 3 risk measures arising from all stages of the PRA. A simplified version of these methods has been adopted for the NUREG-1150 PRAs. 7 refs., 1 fig.

3514 **(SKB-TR—86-18) Technology and cost for decommissioning the Swedish nuclear power plants.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). May 1986. 69p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753366/JAW.

The study shows that, from the viewpoint of radiological safety, a nuclear power plant can be dismantled immediately after it has been shut down and the fuel has been removed, which is estimated to take about one year. Most of the equipment that will be used in decommissioning is already available and is used routinely in maintenance and rebuilding work at the nuclear power plants. Special equipment need only be developed for dismantlement of the reactor vessel and for demolishing of heavy concrete structures. The dismantling of a nuclear power plant can be accomplished in about five years, with an average labour force of about 200 men. The maximum labour force required for Ringhals 1 has been estimated at about 500 men during the first years, when active systems are being dismantled in a number of fronts in the plant. During the last years when the buildings are being demolished, approximately 50 men are required. In order to limit the labour requirement and the dose burden to the personnel, the material is taken out in as large pieces as possible. The cost of decommissioning a boiling water reactor (BWR) of the size of Ringhals 1 has been estimated to be about MSEK 540 in January 1986 prices, and for a pressurized water reactor (PWR, Ringhals 2) about MSEK 460. The cost for the other Swedish nuclear power plants lie in the range of MSEK 410-760. These are the direct cost for the decommissioning

work, to which must be added the costs of transportation and disposal of the decommissioning waste, about 100,000 m/sup3/. These costs have been estimated to be about MSEK 600 for the 12 Swedish reactors.

3515 **(SRD/HSE/R—319) Using concentration data to track clouds in the Thorney Island experiments.** Brighton, P.W.M. (UKAEA Safety and Reliability Directorate, Culcheth). Dec 1986. 96p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900112/JAW.

This report gives full details of a method of estimating the horizontal extent and the translational speed of the heavy gas clouds released in Thorney Island Phase I Trials. We first find the cloud envelope which bounds the area over which gas passed. A geometrical construction allows estimation of the position and size of the cloud as its boundary crosses a given point. Arrival and departure times found from concentration records are used to relate cloud geometry to time. A full listing of these times is given. 11 refs., 4 figs.

3516 **(SRD/HSE/R—410) Discharge of liquid ammonia to moist atmospheres: Survey of experimental data and model for estimating initial conditions for dispersion calculations.** Wheatley, C.J. (UKAEA Safety and Reliability Directorate, Culcheth). Apr 1987. 52p. United Kingdom Energy Authority, Wigshaw Lane, Culcheth, WA3 4NE. Order Number TI88900118/JAW.

A mathematical model is proposed for estimating concentrations near an accidental release of liquefied ammonia from a hole in a tank wall or from a severed pipe. Three quantities are particularly important for hazard assessment: the discharge rate; the fraction of liquid which rains out of the two-phase jet; and the amount of dilution with air up to a point where atmospheric mixing or gravitational effects become important. As well as these, the model includes the chemical interaction of ammonia with atmospheric water vapour: this influences the mixture density and thus the rate of dilution in a subsequent heavy-gas dispersion phase. Part I is a survey of relevant experimental data. In Part II, the mathematical details of the integral model are developed in sufficient detail for implementation in a computer code.

3517 **(SSI—86-17) Recurrent analysis of radiation protection conditions at the nuclear power station. Ringhals power station, Unit 1, 1986.** (National Inst. of Radiation Protection, Stockholm (Sweden)). 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753029/JAW.

Also available in Swediah as SSI--86-15.

National Institute of Radiation Protection has cause of the Government Bill 1980/1981:90 analysed following viewpoints of radiation protection: - Occupational exposes. - Dose rate trends. - Implemented and planned measures of importance from the viewpoint of radiation protection. - Releases and environmental impact. - Organisation and training in radiation protection. (authors).

3518 **Investigation of a reactor coolant pump seal from Indian Point Unit No. 2.** Czajkowski, C.J. (Brookhaven National Lab., Upton, NY). *International Journal of Pressure Vessels and Piping;* **27**: No. 5, 325-334(1987).

A failure investigation was performed on a Westinghouse reactor coolant pump seal from the Indian Point No. 2 Nuclear Power Station. The investigation consisted of visual inspection and SEM/EDS evaluation of rubber seals associated with the main seal. No operating/leakage history was available for the seal evaluated. The conclusions drawn from the investigation were that the only damage to sealing surfaces appeared to be associated with the rubber products (no obvious metal wear) which had their effective cross-sections severely worn. The report recommends the feasibility of only replacing the rubber components and the minimization or elimination of dry starts on the seals.

3519 **Real time tritium monitoring at the Tokamak Fusion Test Reactor.** Gentile, C.A. Jr. (Princeton Univ., Plasma Physics Lab., P.O. Box 451, Princeton, NJ 08544). pp 214-216 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The Tokamak Fusion Test Reactor (TFTR) employs a real time Radiation Monitoring System (RMS) which is comprised of 80 radiation monitors of 6 varying types. The RMS is divided into two specific groups. The Environmental Radiation Monitoring Group are those monitors which include 12 neutron detectors, 12 gamma detectors, and 5 continuous air monitors which are located along the outside of the TFTR Test Cell (and roof), as well as along the perimeter of the Exclusion Zone Boundary. These monitors are used to detect pulsed gamma and neutron radiations generated from the current operation of TFTR. The Tritium Radiation Monitoring Group are those monitors which include 41 kanne detectors 8 differentiating activated air/tritium detectors, and 2 discriminating tritium oxide/elemental tritium detectors. These monitors are spread throughout the TFTR facility for the purpose of detecting different forms of tritium in varying atmospheres. This paper addresses those monitors which make up the Real Time Tritium Monitoring System.

3520 **Activation measurements on the Tokamak Fusion Test Reactor (TFTR).** Gilbert, J.D.; Stencel, J.R.; Couch, J.G.; Fennimore, J.J. (Princeton Plasma Physics Lab., Princeton, NJ 08544). pp 365-369 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The Tokamak Fusion Test Reactor (TFTR) is the largest operating magnetically confined fusion research device in the United States. In the deuterium-deuterium (D-D) mode it has set new neutron production records in its "super-shot" regime on the order of 10/sup 16/ n/sec. The production of small quantities of tritium during these runs also means that some deuterium-tritium (D-T) reactions produce 14 MeV neutrons and thereby increase activation. This paper discusses activation measurements and how the observed radionuclides compare to predictions made for TFTR. Presently, Mn-54, Co-58, Mn-56 and Co-60 are now detectable, along with Br-82 from G-10 electrical insulation. Therefore, procedures for access to the tokamak area now incorporate health physics considerations.

3521 **Retrospective view of fast reactor safety - EBR-1 to the present.** Hummel, H.H. (Argonne National Lab., IL, USA). pp 519-524 of Science and technology of fast reactor safety. Vol. 1. Proceedings of an international conference held in Guernsey on 12-16 May 1986. London, England; BNES (1986). (CONF-860501—).

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

In the thirty-odd years that core-disruptive accidents have been analyzed, great advances have been made both in understanding the physical phenomena involved and in development of computational techniques to deal with them. More realistic modeling has tended to reduce predicted accident consequences. Some safety issues have been satisfactorily resolved, but some new ones have arisen. The unprotected loss-of-flow accident continues to be a source of potentially significant energetics should core disruption occur.

3522 **(BNL-tr—1059) Fast leak of a channel filled with helium at a pressure of 2 bars (channel H5).** Bauer, E.; Tribolet, J. (Institut Max von Laue - Paul Langevin, 75 - Paris (France)). [1987]. Contract AC02-76CH00016. Translation of EB-JT/od-82-99, Feb. 7, 1982. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001467/JAW.

The loss of seal of a helium-filled channel opening the entire cross section of the front part leads to a fast leak. The channel fills to the upper generatrix of the leak orifice and part of the helium contained in the channel escapes into the circuit. The pressure drop in the reflector can lead to reactor and main pump shutdown. On the other hand, the Cooling Circuit Shutdown Bar circuit pumps remain in operation. This paper evaluates the consequences of an incident of this nature for the reactor and the surrounding experimental zones.

3523 **(BNL-tr—1061) Consequences of corrosion of the high flux reactor channels.** (Institut Laue-Langevin, 38 - Grenoble (France)). [1987]. Contract AC02-76CH00016. Translation of EB/od-89 a, Dec. 9, 1981. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001468/JAW.

The effects of corrosion can increase the probability of the channel losing its seal. In case of a slow leak, the phenomena happening can be considered as quasi-static. The closing of the safety valve takes place even before the leak water reaches the level of the exit window. In case of a fast leak in the case of helium filled channels, the dynamic effects are limited to the front part of the plug. As for the back part of the plug and the housing/safety valve unit, the consequences of a fast leak can be assimilated to those of a slow leak. This paper evaluates the results of an incident such as this for the reactor and the surrounding experimental zones.

3524 **(BNL-tr—1058) Fast leak in channel H9.** Bauer, E. (Institut Max von Laue - Paul Langevin, 75 - Paris (France)). [1987]. Contract AC02-76CH00016. Translation of EB/od-82-100, Feb. 8, 1982. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001466/JAW.

The loss of seal of the H9 channel in vacuum, freeing the entire cross section of the front part, leads to a fast leak that progresses rapidly. The effect of depressurizing the reflector can leads to shutdown of the shutdown rod pumps. The source changer associated with the channel fills completely before the valve closes. All of the leak water remains contained within the source changer containment. After the valves open, cooling of the fuel element is handled by natural convection, requiring a reversal of the flow between the plates. This changeover, which takes place at a relatively low pressure level, could lead to local boiling in the fuel element. Consequently, irreversible transformations cannot be excluded as possibilities for the fuel element and even for the control rod. Subsequently, the can is refilled with heavy water with establishment of the usual pressure levels.

25 ENERGY STORAGE

2509 Batteries

REFER ALSO TO CITATION(S) 3565, 3758

3525 **(AD-A—183707/9/XAB) Applications of multivalent ionic conductors to polymeric electrolyte batteries. Technical report No. 8, September 1986-August 1987.** Cherng, J.Y.; Owens, B.B.; Smyrl, W.H.; Munshi, M.Z. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Jul 1987. 4p. NTIS, PC A02/MF A01.

Fast-ion conduction has been demonstrated in certain polymer materials doped with an alkali metal salt. Recently, divalent salts have also been used in the preparation of ionically conducting polymers. Certain complexes were found to be anion conductors while others were cation conductors. It is, therefore, of interest to study the reasons for the apparent difference. Alternating-current measurements are currently being evaluated on a number of polymer divalent salt complexes. Electrochemical cells are being constructed with appropriate cathodes to assess the feasibility of these polymer electrolytes in rechargeable batteries.

3526 **(AD-A—183733/5/XAB) Ionically conductive polymers: application to solid-state batteries. Technical report, September 1986-August 1987.** Owens, B.B.; Munshi, M.Z.; Skarstad, P.M. (Minnesota Univ., Minneapolis (USA). Corrosion Research Center). Jul 1987. 6p. (TR—9). NTIS, PC A02/MF A01.

The use of polymeric ionically conducting electrolyte materials in the fabrication of solid-state batteries was proposed approximately ten years ago. Subsequently, a large number of groups have investigated a variety of polymer electrolytes, such as the polyethylene oxide complexes of various lithium salts. Independent efforts were concurrently expended on polymer electrodes, such as polyacetylene, for batteries. The feasibility of batteries of either type has been tested in a variety of research cells, and in some prototype hardware of practical size. Nonetheless, there are at present no commercially available polymer batteries of either type. A stable battery design with the ability to store and to deliver energy efficiently and economically is the prime objective of the development programs in polymeric batteries.

3527 **(AD-A—183767/3/XAB) Solid-state batteries. Technical report No. 7, September 1986-August 1987.** Munshi, M.Z.; Ownes, B.B. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1987. 58p. NTIS, PC A04/MF A01.

Pub. in Supersonic Solids and Solid Electrolytes: Recent Trends, 1987.

Solid state batteries have evolved from the investigations of ionic transport in solid state materials. The work on solid-electrode materials, especially intercalation compounds has resulted in a variety of solid-state rechargeable-battery designs. The electrolytes and the electrode systems are based on silver, copper, sodium, lithium, proton, and fluoride ion conductors. More recently the discovery of ionically and electronically conducting polymer materials has led to novel designs for very thin battery structures.

3528 **(AD-A—183841/6/XAB) Optimization and scale-up performances of polymer-electrolyte batteries. Technical report No. 10, September 1986-August 1987.** Munshi, M.Z.; Owens, B.B. (Minnesota Univ., Minneapolis (USA). Corrosion Research Center). Jul 1987. 4p. NTIS, PC A02/MF A01.

The rechargeable high energy-density polymer-electrolyte battery utilizing a lithium anode, poly(ethylene oxide)-salt complex electrolyte and Vanadium oxide composite cathode is being investigated in this laboratory. Cycled tests indicated good adhesion at the anode/electrolyte and electrolyte/cathode interfaces, even after one-hundred deep cycles. Results are also presented on the morphological changes taking place at the cathode. A modified polymer electrolyte with relatively higher room-temperature ionic conductivity was also employed in cells at ambient temperatures. Scaled-up designs are under evaluation.

3529 **(AD-A—183884/6/XAB) Oxygen-evolution kinetics at porous nickel electrodes. Technical report.** Zimmerman, A.H.; Effa, P.K. (Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab.). 3 Aug 1987. 27p. (TR—0086(6945)-4). NTIS, PC A03/MF A01.

The impedance of porous nickel electrodes was measured under conditions of steady-state oxygen evolution. Significant effects are observed due to the pore structure of the electrodes, and these effects are found to correlate with loading levels, performance, and composition. The oxygen-evolution characteristics of sintered-plate electrodes were investigated as a convenient means for determining the structural uniformity and the overall quality of such plates for use as battery electrodes.

3530 **(BNL—40320) Ionically conducting polymers: Principles and properties of solid electrolytes.** Skotheim, T.; Okamoto, Y. (Brookhaven National Lab., Upton, NY (USA); Polytechnic Univ., Brooklyn, NY (USA). Dept. of Chemistry). 1987. Contract AC02-76CH00016. 21p. (CONF-8710178—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001552/JAW.

From Short course on electroactive polymers; New Paltz, NY, USA (28 Oct 1987).

The recent success in developing rechargeable lithium batteries incorporating polyether-based electrolytes has led to the anticipation of a wider use of polymer electrolytes in a host of different applications. The polymers with the best combinations of solvation power, conductivity and electrochemical stability are all based on either PEO or polymers incorporating a high density of EO units. PEO-based electrolytes still yield the highest conductivities at elevated temperatures (~100°C) when it is completely amorphous. What has emerged during the last ten years of research on polymer electrolytes is the central importance of the amorphous state for high conductivity, where the ion mobility is governed by the mobility associated with a low glass transition temperature. The difference between polymer and liquid electrolytes is that in the former the solvating part does not migrate with the ions. There is, however, still some controversy concerning the nature of the ionic species, i.e. whether the salt is present in the form of associated ions. The intensive research of the last few years has led to a far better understanding of these polymer-ion complexes. Several different types of solvating polymers have been developed, in particular single ion conductors, which represent much of the future of ion conducting polymer research. 36 refs.

3531 **(CONF-871121—Summs.) Extended abstracts: Eighth battery and electrochemical contractors' conference.** (Battelle Columbus Labs., OH (USA); Battelle Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 318p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88000960/JAW.

From 8. battery and electrochemical contractors' conference; Tyson Corner, VA, USA (16 Nov 1987).

This document contains the extended abstracts for presentations scheduled at the Eighth Battery and Electrochemical Contractors' Conference, highlighting research supported by the US Department of Energy and the Electric Power Research Institute. It is intended to be a technical overview for engineers and scientists in government, industry, and academia who are interested in learning more about electrochemical energy storage. The abstracts are grouped according to the following technical sessions: Introductory Session; Sodium/Sulfur Battery Development; Aqueous Battery Development; Performance, Testing, and Demonstration; Planning, Analysis, and Technology Transfer; Applied Science Research; Metal/Air Batteries; and Fuel Cells.

3532 **(EUR—10959-EN) Anglo-Danish advanced battery project. Final report for the period 1.2.1986-30.6.1986.** Hooper, A.; North, J.M.; Taylor, R.I.; Daniels, L.C.; Horsley, G.; Oliver, M.R.; Hawkins, A.J. (Commission of the European Communities, Luxembourg. Directorate General Telecommunications, Information Industries and Innovation). 1987. 31p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

A number of aspects relevant to the scale-up of all-solid-state, polymeric electrolyte, rechargeable lithium batteries have been studied. A nominal 1.7 Ah cell has been fabricated and cycled at 120/sup 0/C. At the 17 hour discharge rate, the initial cathode utilization, between voltage limits of 2.0 and 2.9 volts, is ≃ 70% theoretical, falling to 20% after 50 cycles. The controlled production of the cathode material, V/sub 6/O/sub 13/, has been studied in detail. 1/2 kg batches of pure material have been produced using a technique which may be utilized on an industrial scale. Thermal modelling studies have provided useful information regarding the potential thermal behaviour of cells. Small internally generated temperature rises are predicted for cells operating at rates consistent with vehicle traction applications. The effect of cell size and the role of inter-cell connectors have been evaluated in specific cases. Work to date indicates the importance of the particular duty or driving cycle in determining the effective thermal behaviour of cells and batteries.

3533 **(SAND—87-7153C) Making space nickel/hydrogen batteries lighter and less expensive.** Dunlop, J.D.; Beauchamp, R. (COMSAT Labs., Clarksburg, MD (USA); Johnson Controls, Inc., Milwaukee, WI (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-8708157—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000168/JAW.

From DARPA conference; Monterey, CA, USA (6 Aug 1987).

A multi-kilowatt-hour nickel/hydrogen battery was designed and developed for terrestrial applications. This battery consists of individual Ni/H_2 cells contained within a common pressure vessel (IC-CPV). Cost studies projected a substantial reduction in manufacturing costs over present aerospace Ni/H_2 batteries. This same design approach is recommended for development of aerospace batteries. An aerospace design concept of an IC-CPV battery is presented. The objective was to make a comparison between this new design approach and the present aerospace technology using individual pressure vessel (IPV) cells. Results of this study show the following potential advantages for this IC-CPV design approach: a 15/1 reduction in cost, a 50% improvement in energy density, and a 3/1 reduction in volume.

3534 **Lithium battery energy monitor.** Johnson, L.J. (to Secretary of the Navy, Washington, DC). US Patent 4,693,119. 15 Sep 1987. Filed date 17 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an apparatus for monitoring the energy level of a battery delivering a load current comprising: means for imparting vibratory motion over a predetermined frequency range; means connected to the battery and operatively coupled to the vibratory motion imparting means having a cantilevered electrode for changing its resonating mass in response to deposits caused by accumulations of the load current; and means electrically coupled to the vibratory motion imparting means for indicating a change of resonant frequency of the resonating mass changing means as more deposits are accumulated on the cantilevered electrode thereby monitoring the energy level of the battery.

3535 **System for agitating the acid in a lead-acid battery.** Weintraub, A.; Mac Cormak, R.S. (to Dept. of Energy, Washington, DC). US Patent 4,693,947. 15 Sep 1987. Filed date 21 Apr 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

The method of agitating acid in a lead-acid battery which comprises the steps of passing compressed air through a humidifier, delivering the compressed humidified air to an air-lift in a battery cell containing acid and bubbling the air up through the air-lift to agitate the acid is described.

29 ENERGY PLANNING AND POLICY

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 2793, 2808, 2824, 2846, 2847, 2848, 2849, 2850, 2866, 2867, 2868, 2976, 3011, 3139, 3209, 3217, 3254, 3538, 3543, 3549, 3554, 4263, 4281, 4321, 4343, 4355, 4428, 4542

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 2809, 2856, 2857, 2859, 2860, 2865, 2883, 2884, 2885, 2932, 2933, 2936, 2940, 2945, 2976, 3047, 3052, 3053, 3054, 3059, 3060, 3122, 3134, 3163, 3167, 3462, 3475, 3487, 3595, 3664, 4069, 4263, 4278, 4280, 4281, 4282, 4321, 4322, 4324, 4337, 4338, 4339, 4342, 4343, 4395, 4396, 4397, 4399, 4427, 4430, 4431, 4432, 4433, 4498, 4542, 4543, 4544

3536 **(AD-A—183719/4/XAB) Final environmental impact statement, Peacekeeper in Minuteman silos, F.E. Warren AFB, Wyoming. Volume 1. Final report.** (Air Force Regional Civil Engineer-MX, Norton AFB, CA (USA)). Jan 1984. 694p. NTIS, PC A99/MF E04.

See also Volume 2, AD-A183 720.

This Final EIS (FEIS), Volume I, addresses the placement of Peacekeeper Intercontinental Ballistic Missiles (ICBMs) in refur-

bished Minuteman III silos at F E Warren AFB, Wyoming. This FEIS describes potential environmental changes to the following environmental resources: employment demand, housing, public finance, construction resources, social well-being, public services and facilities utilities, energy resources, transportation, land use, recreation, cultural resources, visual resources, water resources, biological resources, threatened and endangered species, geologic resources, noise, and air quality.

3537 **(AD-A—183720/2/XAB) Final environmental impact statement, Peacekeeper in Minuteman silos, F.E. Warren AFB, Wyoming. Volume 2. Public comments. Final report.** (Air Force Regional Civil Engineer-MX, Norton AFB, CA (USA)). Jan 1984. 790p. NTISMF E04.

See also Volume 1, AD-A183 719; Availability: Microfiche copies only.

This volume of the Final EIS contains the Public Comments on the Draft EIS, the issues raised, and the answers to those issues.

3538 **(GAO/RCED—87-112BR) Superfund: Funding for the Agency for Toxic Substances and Disease Registry.** (General Accounting Office, Washington, DC (USA)). 1987. 18p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Neither the Environmental Protection Agency nor the Office of Management and Budget is violating the law by reviewing or revising the Agency for Toxic Substances and Disease Registry's budget request before the President submits it to Congress. The review also does not violate section III (n) of the superfund Amendments and Reauthorization Act of 1986 which secures minimum funding for ATSDR that can only be changed by Congress. However, GAO believes that this provision prohibits EPA from specifying how ATSDR should spend superfund money. It is therefore recommending that EPA not place any restrictions on the use of funds earmarked for ATSDR under section III(n) of SARA.

3539 **(NP—8770007) Application of the bubble concept in air pollution abatement - an empirical validation of the bubble theory.** Ballreich, K.L. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Wirtschaftswissenschaften). 23 May 1986. 259p. (In German). NTIS (US Sales Only), PC A12. Order Number DE88770007/JAW.

The author discusses the applicability of the bubble concept in air pollution abatement. Conditions on site are analyzed with a view to their consequences for the application of the bubble concept in West Germany.

3540 **(PB—87-214367/XAB) Environmental profile of Paraguay.** (International Inst. for Environment and Development, Washington, DC (USA)). Dec 1985. 174p. NTIS, PC A08/MF A01.

The social, cultural, physical, and economic dimensions of Paraguay's environment are analyzed to identify main environmental features and problems and to recommend specific actions. The environmental profile presents an overview of Paraguay's ethno-historic and anthropological background, present-day society, and the impact of pollution. Descriptions are presented of: the legal and institutional aspects of environmental policy; the structure and performance of the economy, with focus on the primary and energy sectors; physical resources (climate, geological, mineral, soil, and water resources); and biological resources (vegetation, wild animal life, protected areas, and fish resources).

3541 **(PB—87-222246/XAB) Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the RTECS computer tape (revised). Annual edition.** Sweet, D.V. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1987. 123p. NTIS, PC A06/MF A01.

For system on magnetic tape available as a subscription, see PB—87-900300. Supersedes PB—87-171682.

The 1986 edition of the Registry of Toxic Effects of Chemical Substances (RTECS), formerly known as the Toxic Substances List, is the fifteenth annual revision prepared in compliance with the requirements of Section 20(a)(6) of the Occupational Safety and Health Act of 1970 (Public Law 91-596). The original list was completed on June 28, 1971, and was been updated annually in book format. Beginning in 1977, computer tapes of the complete RTECS file have also been provided. In 1986, these tapes were provided quarterly, in January, April, July, and October. The 1986 edition of the RTECS computer tape, which was issued in January 1987, contains 86,969 substance entries and supersedes all previous RTECS tape editions. A complete description of the various types of data in the RTECS file is contained in the Detailed File Description. The user is strongly encouraged to read the material before processing the data, since the data should not be used until the limitations of the RTECS file regarding data validity, completeness, and applicability are understood.

2904 Natural Resources

REFER ALSO TO CITATION(S) 2808, 4269, 4428, 4430

3542 **(PB—87-217139/XAB) Efficient use of water in irrigation: principles and practices for improving irrigation in arid and semi-arid regions. Technical paper.** Hillel, D. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1987. 118p. (WORLD-BANK-TP—64). NTIS MF A01.

Library of Congress catalog card no. 87-14281; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

The book provides a basic review and analysis of the principles governing soil-crop-water-climate relationships, irrigation, and the efficient utilization of water in arid and semiarid regions. The book contrasts historical and modern approaches to management. It then describes methods of scheduling irrigation and of measuring irrigation water, and compares alternative irrigation systems. Finally, the book discusses some of the human considerations involved in appropriate, and sustainable irrigation systems.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 2807, 2986, 3254, 3457, 3542, 4278

3543 **(PB—87-226478/XAB) Annual review of project performance results (12th).** (International Bank for Reconstruction and Development, Washington, DC (USA)). 1987. 196p. NTIS MF A01.

Library of Congress catalog card no. 82-647135; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

The World Bank reviews the performance of all projects that it has helped to finance. These reviews are based on individual evaluations prepared for each project. The document assesses the performance of the 192 World Bank-supported projects evaluated in 1985. As in previous reviews, the analysis of results for the particular year is presented in the context of past results. The Bank's evaluation of project performance is a two-tier process. The first assessment of project experience is normally made by the operational units concerned in the form of a Project Completion Report (PCR). PCRs are prepared for all completed projects and submitted for review by the staff of the Operations Evaluation Department (OED). In about half the cases, the PCR is used as the basic document in an independent evaluation of the project by OED.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 2932, 2936, 2940, 2945, 2957, 2959, 2976, 2986, 3011, 3053, 3054, 3059, 3061, 3122, 3129, 3134, 3163, 3167, 3428, 3457, 3461, 3462, 3472, 3487, 3511, 4263, 4324, 4498

3544 **(INIS-GB—102) Here be no dragons. A guide to the realities of nuclear power in Scotland.** (South of Scotland Electricity Board, Glasgow (UK)). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750119/JAW.

"Here be dragons" is the phase used by ancient map makers to indicate areas about which they knew nothing or which they suspected contained unknown dangers. The aim of this booklet, "Here be no dragons", is to dispel the myths, misconceptions and misinformation about nuclear power. The South of Scotland Electricity Board explains why nuclear power is important to Scotland economically and deals in a non-technical way with many of the safety issues raised by the presence and operation of nuclear reactors. The environmental issues are also presented simply, with an explanation of the average annual radiation dose to the population of the UK, and a comparison of the radiation doses from the Chernobyl accident, compared to variations in background doses. The risks from nuclear accidents and the risk of death from accidents in industries in the UK compared with the risk from cancers potentially produced among radiation workers, are compared. (U.K.).

3545 **(INIS-mf—10719) Qualitative and, as far as possible, quantitative assessment of the short-term and long-term effect of a nuclear phase-out.** Jaenicke, M.; Mez, L.; Spelthahn, S.; Springmann, F.; Theissen, A.; Ullrich, O.; Leuchtner, J.; Seifried, D. (Institut fuer Oekologische Wirtschaftsforschung (IOEW) G.m.b.H., Berlin (Germany, F.R.); Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.)). Aug 1986. 244p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750015/JAW.

This survey starts from a series of scenarios or comments on the question of West Germany, leaving the field of nuclear power. These were submitted after the accident at Chernobyl and have gained particular importance in this context. The possibilities of leaving in the short, medium and long term were examined. In a further section, the connection between operation of powerstations and the resulting environmental effects is treated. Economic aspects of leaving the field of nuclear power are examined and the possibilities and potentials of rational energy use (potential saving of electricity, potential of combined heat and power plants and potential from regenerative sources of energy) are estimated.

3546 **(INIS-mf—10729) Chernobyl reactor accident. Facts, interrelations and comparative evaluations of general interest about the risks of nuclear energy.** Rassow, J. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Zentralstelle fuer Forschungs- und Entwicklungstransfer (FET)). 1986. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750184/JAW.

The documentation aims at giving a clearly arranged account of facts, interrelations and comparative evaluations of general interest. It deals with the course of events, atmospheric dispersion and fallout of the substances released and discusses the basic principles of the metering of radioactive radiation, the calculation of body doses and comparative evaluations with the radioactive exposure and risks involved by other sources. The author intends to contribute to an objective discussion about the Chernobyl reactor accident and nuclear energy as such.

3547 (INIS-mf—11045, pp 25-33) **Radioactive waste, the earth's crust, and the human society.** Rometsch, R. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Four billion human beings are living in a thin layer around the planet Earth. Life has always been at risk in several ways in the limited space defined by the interface between the earth and the atmosphere: Cosmic changes could be so overwhelming that we do not even want to consider them. We have learned to live and die in natural catastrophes caused by the continuous movement of matter in the outer part of the earth's crust and the surrounding biosphere. And there are those effects resulting from human activities. Although we do not like to admit it, perhaps the greatest danger lies in the human character itself; the root of killing and wars. The growing number of human beings gives rise to a greater impact on the environment. The nuclear debate has sharpened our wits with regard to the special case of radioactive wastes, perceived by large parts of the population as a particular threat. Hence, their management and disposal has become a test case to prove that human society is capable of keeping the environment essentially free of these waste products. This explains the worldwide efforts in this field - and also this conference. The results already achieved with regard to radioactive wastes justifies hopes that it will become possible, technically as well as politically, to control all kinds of toxic by-products of our technical civilization.

3548 (INIS-mf—11045, pp 717-742) **Communications: roots of the problem.** Olds, F.C. (Energy Communications, Illinois, United States of America). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Waste management programs are having great difficulty in gaining public and political acceptance in a number of countries. Communications have played a major role in this adverse development. The spectrum of communications consists of many types of information exchange. At one end of the spectrum is the scientific peer-group discussion through which a consensus of technical truth is established. At the other end of the spectrum lies the political type of communication, the goal of which is to win scientific truths, not withstanding. Opponents of nuclear power have had much more success in their use of political types of communications than the proponents have had in their use of scientific facts. The reasons for this difference in degrees of success are set forth. Political and social trends play an important role. For example, the trend toward what is called 'participatory democracy' is advantageous for nuclear power opponents because it puts the power of making final decisions on complex matters into the hands of masses of people who lack the knowledge by which to arrive at intelligent decisions. All these adverse factors, however weighty they are, should not have rendered the nuclear industry as helpless as it seems to be in its quest for public and political acceptance. There are some 50 ways of reaching the public and the politicians that do not depend on such mass media vehicles as TV and newspapers. These 50 are under-utilized by the nuclear community.

3549 **(NEI-SE—2) Preparedness against nuclear power accidents.** (Civil Defence Administration, Karlstad (Sweden); National Inst. of Radiation Protection, Stockholm (Sweden)). 1985. 20p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753055/JAW.

This booklet contains information about the organization against nuclear power accidents, which exist in the four Swedish counties with nuclear power plants. It is aimed at classes 7-9 of the Swedish schools. (L.E.).

3550 **(SMC-OP—10) Teaching nuclear issues.** Hicks, D.W. (Saint Martin's Coll., Lancaster (UK). Centre for Peace Studies). 1986. 40p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

This paper is based on the assumption that the nuclear debate, both globally and within Britain, is one of critical importance in the late twentieth century and that it should therefore, at some juncture, be explored as part of the school curriculum. An essential part of 'good education' in a democratic society is to teach young people how to think about such an issue, but not what to think about it. This paper attempts to set out some of the key issues and dilemmas in relation to what we may call 'nuclear education'. It perhaps asks more questions than it gives answers, but they are all essential questions which teachers must ask themselves if they are to teach sensitively about these matters. Some of these questions are given as examples.

3551 **(WP—86-80) First-order effects of a nuclear moratorium in Central Europe.** Messner, S.; Strubegger, M. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Dec 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700083/JAW.

An energy supply model developed at IIASA previously is used to investigate the consequences of a hypothetical nuclear power phaseout in Central Europe. It is assumed that no new nuclear power plants will be built in Central Europe after 1990 but the existing ones will be used for a planned lifetime of 25 years. Energy-specific consequences, import dependence, emissions, energy prices and investments from the energy sector are considered. (G.Q.).

3552 **(WP—87-15) Ways of transition to clean energy use: two methodological approaches.** Belyaev, L.S.; Kaganovich, B.M.; Krutov, A.N.; Filippov, S.P.; Martinsen, D.; Mueller, M.; Wagner, H.J.; Walbeck, M. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Jan 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700084/JAW.

Studies of the Siberian Energy Institute, Irkutsk, and the Nuclear Research Center, Juelich, carried out with the aid of complex computer models, demonstrate the opportunities of novel integrated energy systems in a future, clean energy supply. As conditions differ widely in different regions and different countries, there will of course be a wide structural variety in the realization of integrated energy systems. The studies of SEI and KFA, based on the cooperation with the International Institute of Applied System Analysis (IIASA), emphasize the common viewpoint that the idea of integrated energy systems constitutes an essential basis for future studies on 'energy in a finite environment'.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 3475

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 3290

2910 Conservation

REFER ALSO TO CITATION(S) 3586, 3593, 3594

3553 **(IIUG—87-3) Energy conservation at the local level. Competing energy advisory services in a German municipality.** Hildebrandt, L.; Joerges, B. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1987. 88p. Wissenschaftszentrum Berlin, Germany, F.R. Internationales Inst. fuer Umwelt und Gesellschaft.

This study was devoted to a comparative analysis of the factors making for the relative success of four different local energy conservation programmes in a community. While local programmes achieve high levels of programme use and consequent conservation actions among private family households, the overall level of penetration remains unsatisfactory, particularly in the case of disadvantaged consumer groups such as low-income and tenant households. In addition, programme involvement is strongly associated with previous commitment to energy conservation and a general involvement in local communication networks. Beyond these general features, the four programmes differ markedly with respect to the particular clientele they attract or select. All four local programmes are not sufficiently integrated with more comprehensive communal planning and relevant policy as well as administrative structures.

3554 **(PB—87-225306/XAB) Household energy handbook: an interim guide and reference manual. World Bank technical paper.** Leach, G.; Gowen, M. (International Bank for Reconstruction and Development, Washington, DC (USA)). 1987. 201p. (WORLD-BANK-TP—67). NTISMF A01.

Library of Congress catalog card no. 87-18864; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

A standard framework for measuring and assessing technical information on the household energy sector in developing countries is needed. The handbook is intended as a first step toward creating such a framework. Chapter I discusses energy terms and principles underlying the energy units, definitions, and calculations presented in the following chapters. Chapter II describes household consumption patterns and their relationship to income, location, and household-size variables. Chapter III evaluates energy end uses and the technologies that provide cooking, lighting, refrigeration, and space-heating services. Chapter IV examines household energy resources and supplies, focusing on traditional biomass fuels. Finally, Chapter V demonstrates simple assessment methods and presents case studies to illustrate how household energy data can be used in different types of assessments.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 2850, 2886

3555 **(INIS-mf—10723) Energy report of the Federal German Government.** (Bundesministerium fuer Wirtschaft, Bonn (Germany, F.R.)). 24 Sep 1986. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750023/JAW.

In its governmental declaration of May 4th, 1983, the Federal German Government has pointed out how it will safeguard the continuous, economical, and non-polluting supply of energy to the Federal Republic of Germany. By that report the Federal Government strikes a balance of its policy and defines its position with regard to topical questions, especially the peaceful use of nuclear energy. The report comprises four chapters: 1. peaceful use of nuclear energy in the Federal Republic of Germany, 2. Summary statement on energy policy, 3. Current situation in the energy market and long-term perspectives, 4. Points of main emphasis of future energy policy.

3556 **(INIS-mf—10726) Chernobyl and the future of energy supplies in the Federal Republic of Germany. Summaries.** (Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany, F.R.)). 1986. 14p. (In German). (CONF-8609335—Summs.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750153/JAW.

From AGF congress on Chernobyl and the future of energy supply in the Federal Republic of Germany; Bonn, F.R. Germany (17 Sep 1986).

Impressions of a polar explorer attending the meeting are given, summarizing the main statements presented there. The ten papers reviewed deal with problems of reactor safety, radiation dose to the population, and alternative approaches of the energy industry. The congress has been intended to show the efficiency of the government-sponsored research establishments in the attempt to master the problems of future energy supplies. Any concept developed for this task faces the requirements of feasibility, safety, and economic efficiency.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 2807, 2809, 2823, 2824, 2852, 2856, 2857, 2860, 2861, 2862, 2874, 2875, 2876, 2877, 2878, 2879, 2880, 2881, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2895, 2900, 2901, 2902, 2903, 2904, 2907, 2908, 2914, 3052, 3053, 3054, 3059, 3060, 3061, 3122, 3167, 3218, 3219, 3220, 3221, 3344, 3345, 3359, 3428, 3487, 3538, 3555, 3640, 4020, 4263, 4281, 4498

3557 (IAEA-TECDOC—428, pp 229-237) **Present status and trends in SO/sub 2/ and NO/sub x/ emission control regulations in Europe.** Ellison, W. (Ellison Consultants, Monrovia, MD, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

1983 West German legislation (GFAVO) calls for retrofitting by 1988 of FGD facilities of a minimum of 85% sulfur dioxide (SO2) removal efficiency, with stack emission no greater than 400 milligrams (mg) per normal cubic meter (Nm/sup 3/) of flue gas, for new and existing boilers greater than approximately 110 megawatts i.e. MW(e), size. As of 1986, more than 100 FGD sys-

tems with greater than 40,000 MW(e) aggregate capacity have been purchased in West Germany alone. 1983 West German legislation requires by 1993 the retrofit addition of approximately 400 more FGD installations aggregating approximately 25,000 MW(e) of capacity on boilers in the size range 35 to 110 MW(e). Stringent West German SO2 legislation in 1983 was followed in 1984 by enactment of very strict new nitrogen oxides (NOx) limits calling for emissions of no more than 200 mg NOx, measured as nitrogen dioxide, NO2, per Nm/sup 3/, approximately 0.16 lb NO2 per million Btu heat input, for existing and new boilers greater than 110 MW(e), size. As of 1986 approximately 50 high-efficiency commercial systems aggregating more than 10,000 MW(e) capacity, most for retrofit addition, have been purchased in West Germany alone, and approximately 30,000 MW(e) of additional NOx removal capacity will be required to be retrofitted by deadlines during the period 1988 to 1990. For comparative purposes a brief description is given of regulations in North America for control of SO2 and NOx emissions from large coal-fired boilers. 7 refs, 4 tabs.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 2793, 2809, 2823, 2824, 2824, 2829, 2846, 2846, 2847, 2847, 2848, 2849, 2850, 2852, 2857, 2860, 2861, 2862, 2865, 2866, 2867, 2868, 2869, 2874, 2875, 2876, 2877, 2878, 2879, 2880, 2881, 2886, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2895, 2900, 2901, 2902, 2903, 2904, 2907, 2908, 2914, 3640, 4073

3558 (ERCB/C—870519) Hearing date and procedures. Canadian Occidental Petroleum Ltd. Petrogas Processing Ltd. Northeast Calgary area. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 19 May 1987. 7p. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

Canadian Occidental Petroleum Ltd. and Petrogas Processing Ltd. (Canadian Oxy) applied for a license to drill a well and for permits to construct sour gas and related pipelines in Northeast Calgary in 1984. In December 1985, Canadian Oxy submitted new applications. Since a hazard assessment by Concord Scientific Corp. was nearing completion, a pre-hearing meeting was held to consider the status of the Concord Study, the need and timing for a hearing, identifying issues to be addressed, and intervener funding. The meeting was held in April 1987; this report reflects comments and decisions.

3559 (PB—87-224978/XAB) Initial examination of management stress in the coal-mining industry and possible avenues for its reduction at source. Final report, April 1985-April 1986. Ferguson, C.A.; Collier, S.G. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1987. 55p. (TM—87/04). NTIS, PC E06/MF E06.

The report identifies the principal sources of management stress in the mining industry, and examines the potential for new technology management aids and organizational design in ameliorating stress. An extensive survey by questionnaire was to be followed by a series of interviews with managers designed to ensure accurate interpretation of the results of the survey. The report describes: the construction of the pilot questionnaire and the methods required for analysis of the results.

2960 Electric Power

REFER ALSO TO CITATION(S) 3218, 3219, 3220, 3221, 3344, 3345, 3359, 3544, 4433

3560 (DOE/EIA—0397(87/2Q)) Electric power quarterly, April-June 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Oct 1987. 342p. NTIS, PC A15/MF A01 - GPO; 1; GPO Dep. Order Number DE88002153/JAW.

The EPQ presents monthly summaries of electric utility statistics at the national, divisional, state, company, and plant levels on the following subjects: quantity of fuel, cost of fuel, quality of fuel, net generation, fuel consumption, fuel stocks. In addition, the EPQ presents a quarterly summary of reported major disturbances and unusual occurrences. These data are collected on the Form IE-417R. Every electric utility engaged in the generation, transmission, or distribution of electric energy must file a report with DOE if it experiences a major power system emergency.

3561 (EMR/E—M23-7/1986E) Electric power in Canada 1986. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Energy Sector). 1987. 79p. (MICROLOG—87-05383). Electrical Energy Branch, Energy, Mines and Resources Canada, 580 Booth St., Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report assesses the current status of electric power in Canada. A breakdown of the structure of the industry and the provincial utilities is outlined. The federal and provincial regulatory bodies are described. Provincial electricity consumption and generation are tabulated. Both international trade and electricity exports and revenues by province are detailed. Included are transmission data and figures for electric utility investment and financing. 14 figs., 46 tabs.

3562 (PP—86-1) Capital goods for energy development: power equipment for developing countries. Parikh, J.K. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Jan 1986. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700067/JAW.

Questions of energy policy in developing countries are considered, with the goal of 'evolution from exports to indigenization' i.e. independence. Levels of technologies are considered in relation to the resources of each country. Nuclear power is considered among other energy sources. (G.Q.).

3563 (RR—83-9) Fueling Europe in the future. Sassin, W.; Hoelzl, A.; Rogner, H.-H.; Schrattenholzer, L. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Mar 1983. 103p. (EUR—8421). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700069/JAW.

An opportunity to test the applicability of the global study 'Energy in A Finite World' 1981 arose with the Energy Systems Program Group's cooperation with the services of the European Communities in investigating the energy problem emerging in the EC countries and the R and D strategies they are seeking to develop in response. The three-year-study, supported by two contracts from the Directorate General for Research, Science, and Education of the Commission of the European Communities, highlighted the complexities of international interdependence. It is documented in this report. The report identifies some of the conflicts and differences that may arise between regional outlooks and a global perspective; between the balancing of demand and supply in a cooperating world, and the furthering of the objectives of a group of countries such as the EC in a competitive world. Some possibilities were explored of how to resolve these conflicts by way of alternative energy R and D strategies. These strategies were formulated as energy scenarios for the EC. (Author, shortened by G.Q.).

3564 (WP—86-30) Natural resources and energy systems: a strategic perspective. Lee, T.H.; Schmidt, E.; Anderer, J. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Jun 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700082/JAW.

Oil prices falls to below ten dollar a barrel. US synfuel program cancelled after billions of dollars are invested. Tennessee Valley Authority tries to sell unfinished nuclear plants to China. Completed nuclear plant stands idle in Austria. Canadians seek uses for excess power from Candu plants. A glut of cheap oil, a general excess of operating nuclear capacity, an ever growing number of mothballed or not quite completed non-operating nuclear plants. Today the formidable challenge is to use abundant energy sources in ways that support social and economic development and protect the environment. In this paper we seek to provide a strategic perspective on how to meet this challenge. Toward this end, we explore the misconceptions of the past that led to costly errors in energy planning. The issue here is to dispel the myth of resource

depletion as the driving force for the shift from one energy source to another. To gain insight into the actual basis for energy substitution, we turn our attention to energy patterns, viewing these in retrospect and prospect. This review of energy development provides an opportunity to consider some of the environmental implications of the expanded use of energy resources. These findings are then drawn together in an attempt to highlight certain R and D options that we believe offer a sound basis for strategic energy management. (Author, shortened by G.Q.).

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 3209, 3556

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 2817

3005 Fuel Cells

REFER ALSO TO CITATION(S) 3531

3565 **(AD-A—183659/2/XAB) New materials for electrochemical cells. Final report, 1 January 1983-31 December 1986.** Goodenough, J.B.; Dickens, P.G. (Oxford Univ. (UK). Inorganic Chemistry Lab.). 20 Jun 1987. 9p. NTIS, PC A02/MF A01.

The research had two main aims: (i) determination of the thermochemical, structural, and electrochemical properties of insertion compounds and materials showing mixed electronic/ionic conduction, and (ii) the design, preparation and characterization of new materials for use as electrolytes or cathode materials in solid-state cells. The progress of this research has been described in the series of scientific reports and renewal proposals submitted during the research period and discussed in detail through scientific publications. New ambient-temperature lithium- and hydrogen-insertion compounds were prepared from the uranium oxides U_3O_8, alpha, gamma and delta UO_3. Electrochemical and thermochemical parameters were determined for these phases and also for the hydrogen-insertion compounds of vanadium oxide mixed molybdenum-tungsten trioxides and new structural modifications tungsten oxide and molybdenum oxide; the phase previously known as hexagonal MoO_3 has been shown to be a partially deammoniated and dehydrated ammonium decamolybdate.

3566 **(DOE/FE/60040—2374) Field testing of DOD fuel cell power plants: Final report.** Ferraro, V.D.; Hegebarth, D.G.; Taylor, R.W. (Science Applications International Corp., San Diego, CA (USA). Energy Systems and Conservation Div.). Jun 1987. Contract AC21-82FE60040. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE87006494/JAW.

The field testing of four 40-kW fuel cell power plants at four military bases has achieved a number of important goals and objectives. The field test indicates that the basic on-site fuel cell technology is close to commercial viability. Two of the three main components, the fuel processor and power section, performed well without any major operating problems. Three sites experienced problems with the power conditioner section of the power plant, specifically the inverter. Inverter logic problems required these power plants to be operated at reduced load levels during most of the field test. Another area that needs improvement concerns unit coolant leaks and the periodic cleaning required for the power plant's water cooling system. Improvements must also be made in the conventional components selected for the auxiliary systems; i.e., pumps, regulators, valves, piping; as they caused many nuisance type problems. Average electrical efficiencies of 32% (based on the HHV of input gas) were achieved by all four units. Low audio noise was achieved by all four units, 60 dB(A) or less at 15 feet (horizontally) from the power plant. Electrical power output quality and the electrical protection characteristics were compatible with the electric grid. Thermal energy output was compatible with the site interfaces. A high availability of 81% was achieved by the unit at Elmendorf AFB. 23,713 hours of operation had been achieved by the four units as of October 1, 1986. The units at Ft. Belvoir and Elmendorf AFB will undergo extended field testing into 1988. As of October 1, 1986, the Elmendorf power plant had 8364 hours and Ft. Belvoir's had 7892 hours. The overall availability of the four power plants was 64% with the Elmendorf unit obtaining 81%, the highest in the DOE/GRI Fuel Cell Project.

3567 **(QU/P—8602) Development of electrodes for solid electrolytes.** Bell, M.F.; Sayer, M. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics). Feb 1986. 43p. (MICROLOG—86-04406). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Electrode materials have been investigated for use in hydrogen-oxygen fuel cells based on proton conducting solid electrolytes. These include plasma-sprayed molybdenum, nickel cobalt oxide NiCo/sub 2/O/sub 4/, and ruthenium oxide RuO/sub 2/, with platinum being used as a standard of comparison. Molybdenum is recommended for use as the hydrogen electrode, while NiCo/sub 2/O/sub 4/ shows considerable promise as an oxygen electrode. Methods are developed for film fabrication, characterisation, and use in specially designed steam cells. The evaluation methods include four-probe conductivity measurements, and a technique for evaluation of film porosity. All three materials are stable in steam at 300/sup 0/C, but platinum degrades in acidic environments and/or under strong hydrogen flow within the electrolyte.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 3290, 3998, 4322

3568 **(ANL/CNSV-TM—189) Institutional Conservation Program evaluation project: Results of elementary and secondary education survey pretest.** Collins, N.E.; Carroll, W.L.; Gaines, L.L.; Hatfield, B.K.; Kier, P.H.; Miller, K.L.; Vine, E.L. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001697/JAW.

As part of a study of energy conservation efforts in schools and hospitals and an evaluation of the Institutional Conservation Program sponsored by the US Department of Energy, survey instruments that will be sent to large numbers of elementary and secondary schools and school districts were pretested. The survey instruments solicit information on energy conservation activities, decision-making processes, and energy use. The pretest had several purposes, including identification of problems in the survey instruments' formats and in the wording of instructions and questions; it also helped in establishing the sampling strategy for the survey itself. Both site visits and mailings were used in the pretest. This report covers all aspects of the pretest. Characteristics of the pretest schools, districts, and interviewees are discussed in narrative summaries. Pretest procedures are described and responses to some of the survey questions are provided.

3569 **(B-Ho—7/82) Influence of the thermal mass of buildings on the energy demand of buildings - an experimental study.** Schwarz, B. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung, e.V., Holzkirchen (Germany, F.R.). Inst. fuer Bauphysik). 13 Aug 1982. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750139/JAW.

Both solar radiation and the thermal mass of buildings are assumed to have an influence on the energy demand of buildings. The study intends to find out about the relevant conditions and extent of influence. Two test rooms characterized by their equal geometry but differing thermal capacities served to determine the influence of the thermal mass on the energy household and on the

temperature behaviour under natural outdoor conditions. The parallel tests were chosen to be performed under extreme conditions, i.e. one super light construction room (thermal insulation of the inner walls) heated by quick-acting air heaters and one super heavy construction room equipped with conventional radiators. The study reports about the proceedings as such (measuring methods, test rooms, marginal conditions, mode of experimental procedure) and discusses the test results which are shown in various diagrams. Even under instationary temperature conditions the heat transition coefficient was being considered the decisive factor to determine outwall heat losses. Provided the continuous operation of the heating systems the percentage energy conservation was found to correspond to the percentage changes of the mean temperature difference between inside and outside air. The solar through-the-windows heat gain does not depend on the design of rooms. (HWJ).

3570 **(BMFT-FB-T—86-197) Optimization of the interplay between district heating and customer's heating systems - summary. Final report.** Brachetti, H.E.; Jung, C.; Manthey, W.; Westhoff, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Fernwaerme-Forschungsinstitut in Hannover e.V., Hemmingen (Germany, F.R.)). Dec 1986. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750005/JAW.

From the analysis of existing heating systems, an easy to use and low-cost measuring technique should be developed, which would make it possible to determine the operating conditions of a heating system in a short time. Moreover simple methods should be found for an operation under the condition of maximum temperature spreading. The temperatures of finned and plate type heating elements of a heating system, built in the 70's were measured by the means of contact thermometers and infrared radiation thermometers. As indicated by the results, most of the examined heating elements did not show the designated temperature distribution. This was caused by several thermo-hydraulic mixing phenomena of reflux water with initial water, as well as zones of dead water, turbulence and so on. Therefore the amount of transfered heat was reduced. The results showed, that the quantities of water, related to the specific heating circuits were usually too high. Operation with maximum spreading will be achieved, when every heating element is passed by the required amount of water. It had been realized that the speed controlled circulation pump was the cheapest method to reach maximum spreading. To measure actual conditions an infrared radiation thermometer was developed, which yields information about the temperature distribution of a heating element in a few seconds. An immediate determination of mass flow rates at every optional point of a piping system was realized by the means of a small vane water meter. In addition to findings about the operation mode of existing heating systems, the project led to the development of a transportable measuring device, consisting of independent components like: Infrared radiation thermometer, small vane water meter, data acquisition unit, microcomputer. With 40 figs., 15 refs.

3571 **(BNL—52080) Advanced condensing heat exchangers: Phase A, Annual report.** Stickford, G.H.; Talbert, S.G.; Agrawal, A.K.; Hindin, B.; Murphy, M.J.; Locklin, D.W.; Bigg, D.; Spinosa, E.D. (Battelle Columbus Labs., OH (USA)). Jan 1987. Contract AC02-76CH00016. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001485/JAW.

This report presents the results of the first year of a research program Battelle is conducting for the Brookhaven National Laboratory. The primary objectives of this program are to resolve the major technical problems which may limit the performance and service life of high efficiency, condensing appliances, and to transfer this technology to the furnace and boiler manufacturing industry.

3572 **(CFS/MA—86/164) Energy conservation in greenhouses. Economical photoperiodic lighting methods.** (Canadian Forestry Service, Fredericton, New Brunswick. Maritimes Div.). Oct 1986. 7p. (MICROLOG—87-03188). Canadian Forestry Service, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, Ont., Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Electricity costs in the Maritimes are high because they are partially tied to the cost of oil. To reduce electrical costs for photoperiodic lighting in greenhouses, the current practice is to interrupt the dark period for 1-2 hours in contrast to extending the day length to 14 hours or more. This publication discusses some techniques of night-break lighting, compares costs, and describes a low-cost moving fluorescent system developed and tested at Canadian Forestry Service - Maritimes. 2 tabs., 2 figs.

3573 **(CG—86) Field evaluation of improved domestic gas furnaces in the Toronto area. Phase 2. Final report.** (Consumers Gas Co. Ltd., Toronto, Ontario (Canada)). 1986. 43p. (MICROLOG—86-02901). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Over the 1982/1983 and 1983/1984 heating seasons, Consumers' Gas Company Ltd., through its Research and Special Projects Department, completed a field testing program to monitor the operation and evaluate the performance of two Lennox G-14 pulse combustion, high efficiency condensing gas furnaces. Through a weekly "flip-flop" monitoring approach, daily heating systems performance and consumption, degree-day and ambient temperature data were gathered and analyzed to compare the seasonal performance of the new generation heating appliances against existing, conventional gas equipment. This report covers much of the work carried out and discusses pertinent project findings, such as problems encountered and occupant perception, together with an account of the experimental procedure. 10 figs., 6 tabs.

3574 **(CG—8106) Programme to conduct a field trial of improved gas furnaces and boilers. Installation data report.** (Consumers Glass Co., Ltd., Toronto, Ontario (Canada)). Jun 1981. 35p. (MICROLOG—86-05487). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Consumers' Gas Company Ltd. initiated a project during October 1980 to field test newly developed gas furnaces and boilers. A programme and methodology were developed for the testing of the equipment. Included is demographic and building data on the sites selected for the field tests.

3575 **(CGA—8701/3) Natural gas appliance installation and training manual.** (Canadian Gas Association, Don Mills, Ontario). Jan 1987. vp. Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $26.00 CAN.

This fifth edition of the Natural Gas Appliance Installation and Training Manual was made possible through the cooperative efforts of the Canadian natural gas industry and the governmental authorities having jurisdiction. It was compiled to provide practical information for safe and efficient installation and servicing of gas appliances. The improvements made to the text and the illustrations in this new edition are consistent with CGA's policy of periodic review to make the manual as current as possible. Included are detailed discussions about piping systems, regulators, devices of measurement and control, gas burners and general gas combustion and flame safety.

3576 **(DOE/BP/11287—2) Regional adaptation of results: The transferability study: Final report, Hood River Conservation Project.** French, S.; Block, S.; Kaplon, S.; Khawaja, M.; Peach, H.G. (Pacific Power and Light Co., Portland, OR (USA)). Oct 1987. Contract AC79-83BP11287. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001383/JAW.

This analysis is presented as a tool to enable researchers to use Hood River Conservation Project data and results for conservation project planning or estimation of savings potential in their own areas. All relevant data bases will be available through the Bonneville data archive as of 1987. The purpose of this analysis was to gauge the extent to which the community of Hood River, Oregon, is comparable to the rest of the Pacific Northwest Region and, with available data bases, to provide tools for more complete modeling

of the region using Project data. Four survey data bases, 1980 US Census, Hood River Baseline Survey, Hood River End-use Survey, and the Pacific Northwest Residential Energy Survey (PNWRES), were compared and developed on three "levels" and in a separate kiloWatt-hour (kWh) analysis. The Project was designed to analyze the conservation retrofit potential of a community as a whole, in addition to collecting detailed information from an extensively monitored end-use sample. The Project differed from conventional weatherization programs in three ways. First, all cost-effective measures were provided virtually free of cost to all electrically heated households in the study area. Second, super levels of cost-effective weatherization measures, including R-49 insulation in ceilings, R-38 in floors and triple-pane windows, were offered to participants. Third, the Project's focus was research. This research assessed the extent to which residential conservation is a workable energy resource for the future.

3577 **(DOE/CE/63472—T1) [Energy related business development grant project]: Final technical progress report.** (CONSERVE, Inc., New York (USA)). 26 Oct 1987. Contract FG01-86CE63472. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001649/JAW.

CONSERVE, Inc., a private, not-for-profit organization, was launched in 1986 to provide energy conservation and weatherization services to low-income neighborhoods throughout New York City. Founded by three non-profit community development groups - Northern Manhattan Improvement Corporation, Operation Open City and the Coalition Management Training Company - CONSERVE, Inc., couples NYS Weatherization Assistance Program funds with privately leveraged dollars to achieve more thorough workscopes and higher energy savings in multi-family buildings housing low-income tenants. CONSERVE's services include: energy audit and workscope preparation, financial analysis and packaging and construction management. During its first year of operation, CONSERVE's primary goal was to test the feasibility of coordinating the services described above by making them available to owners of multi-family buildings and potential lenders. First-year findings proved conclusively CONSERVE's viability as an energy conservation resource for owners and tenants of low-income, multi-family buildings in New York City. Based on its accomplishments as well as its potential, the organization has received full funding for the 1987-88 fiscal year from the NYS Energy Office and the NYS Weatherization Assistance Program. This report documents the organization's activities over the last year.

3578 **(EEL—8701) A feasibility study into commercial/industrial exhaust air heat pumps. Final report.** (Enermodal Engineering Ltd., Waterloo, Ontario (Canada)). Jan 1987. 76p. (MICROLOG—87-03268). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report examines the thermal and economic feasibility of three heat pump heat recovery systems for commercial/industrial applications. The heat pump systems are: exhaust air-to-water, exhaust air-to-supply air, and exhaust air-to-supply air with an intermediate glycol loop. The thermal and economic performance of these systems are compared to two conventional heat recovery systems: air-to-air heat exchanger and glycol run-around loop. An assessment of the potential market size is also made. The systems were compared in eleven Canadian and northern U.S. locations representing a wide range in length of heating season and electricity and natural gas prices. In most of the locations studied, the exhaust air-to-water heat pump offered the greatest energy and cost savings and the shortest payback period. Only in those locations with high electricity prices or low natural gas prices (e.g. Alberta and New England) did the glycol run-around loop offer superior performance. The exhaust air-to-supply air heat pump had equal or slightly poorer payback times when compared to the air-to-air heat exchanger. This heat pump would appear to have its best potential when air conditioning is being added. Despite being a very flexible system, the exhaust air-to-supply air heat pump with an intermediate glycol loop had payback periods beyond what most building owners would accept. 12 figs., 13 tabs.

3579 **(EGG-M—16087) Rotary recuperative magnetic heat pump.** Kirol, L.D.; Dacus, M.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-8706125—15). NTIS, PC A02. Order Number DE88001575/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

A bench scale rotary magnetic heat pump now being built is described. The unique design feature of this heat pump is the method for achieving recuperator fluid flow, which relies simply on parallel flow paths; the primary flow leg allows heat transfer between external load and sink and magnetic working material, while parallel flow accomplishes recuperation. The bench scale test is intended to demonstrate feasibility of the concept and to verify that all significant loss mechanisms are identified and treated poorly in performance models, but is not a scaled down version of a practical heat pump. Working material is gadolinium foil 76 μm thick with 127 μm spaces for fluid flow. Magnetic fields are created by neodymium-iron-boron permanent magnets with an air gap field of about 0.9 Tesla. Due to the low field (practical heat pumps will use superconducting magnets with field strength around 9 T), temperature lift is limited to 11 K. 8 refs., 6 figs.

3580 **(EPRI-EM—5447) Field evaluation of cold air distribution systems: Final report.** Dorgan, C.E.; Elleson, J.S. (Dorgan, McMahon and Associates, Inc., Madison, WI (USA)). Oct 1987. 149p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920071/JAW.

Field performance monitoring was performed at three buildings which use low temperature (42°F to 48°F) air distribution in conjunction with ice storage. Temperatures, humidities, and airflows were monitored using a datalogger, and space conditions were measured. The performance of the systems is analyzed and evaluated based on the data collected. It was found that the various operational problems encountered were generally not related to the use of cold air distribution, and that this technology can be successfully used to cool buildings. Recommendations are made for design refinements for future cold air distribution systems, further research in cold air distribution, and continued field evaluation of cold air distribution systems.

3581 **(EUR—10808-EN) Design and development of absorption heat pumps: Final report.** Smith, I.E. (Cranfield Inst. of Tech., Bedford (UK). School of Mechanical Engineering). 1986. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900082/JAW.

The aim of the research was to demonstrate an absorption heat pump capable of accepting heat from ambient air at building design temperatures, typically ⁻1°C, and elevating it typically to 70°C to supply hydronic central heating systems. An absorbent consisting of a mixture of sodium and potassium hydroxide has been investigated with water as the working fluid and it has been demonstrated that it will accept heat at ⁻5°C and deliver heat 68° higher. If the condenser of the heat pump was operated at temperatures of around 80°C then the heat pump system would meet the above requirement. Liquid water, containing an anti-freeze component has successfully been evaporated at ⁻5°C, and heat transfer coefficients for evaporation at these, and lower temperatures, have been measured. Both film flash evaporation have been investigated in a quantitative manner. The important matter of constructional materials has been investigated through literature review and consultation and no insuperable problems have been identified.

3582 **(MTAM—8703) Development of high efficiency gas-fired domestic water heater (UP-E-201). Final report.** (Modern Times A and M (Canada)). Mar 1987. 109p. (MICROLOG—87-03978). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objectives of this study were to design, develop, construct, and evaluate a prototype high efficiency condensing water heater. The supply of combustion air was to be preheated by the exiting flue gases and both were to pass through the walls of the

house. The term applied to this style of combustion was "balanced flue". The performance of the condensing water heater was acceptable from all technical points of view. The steady state combustion efficiency of the system averaged 92%. Compared to the seasonal efficiency of a conventional gas-fired water heater of 50%, the improved efficiency is substantial. When applied to a relative payback period for an average residential consumption of hot water, the economics for retrofit become questionable.

3583 **(NP—8750011) 'Volkswaermepumpe', meaning an absorption heat-pump at low costs for single and multiple family dwellings. Final report.** Bauch, W.; Meckel, B.; Schott, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750011/JAW.

The works having been performed in the field of development of both components and entire unit design resulted in functional heat pumps of a heat output of 22 kW. It was the aim of this project to make, by corresponding development- and construction works, absorption heat pumps - hitherto having been realized by using American components of absorption water-chillers - a product, which can be offered on the market at lower prices than it was possible before. It was considered an important precondition for the realization of this object to search for materials and components to be taken from existing manufactures. Efforts were made to integrate into the heat pump system such components that are produced in big quantities. The works that have been done indicate, in addition to the corresponding technical improvements, a considerable reduction of costs. The results having been achieved till now will be used for the further development and the integration- and applications-technics. With 6 tabs., 31 figs.

3584 **(ORNL—6337) Weatherization assistance for low-income households: An evaluation of local program performance.** Schweitzer, M.; Rayner, S.; Wolfe, A.K.; Mason, T.W.; Ragins, B.R.; Cartor, R.A. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 253p. NTIS, PC A12. Order Number DE88000984/JAW.

The US Department of Energy's Weatherization Assistance Program (WAP) funds local agencies to provide weatherization services to low-income households. This report describes the most salient features of this program, examines relationships between organization and program outcomes, and presents recommendations for the program's further development. Data were collected by written surveys administered to local weatherization agencies, a telephone survey of 38 states and eight DOE support offices, and site visits to selected local agencies. Locally controlled factors found to be significantly related to program performance include the amount of the weatherization director's time spent on program administration, the use of established client selection criteria, the frequency of evaluation of local goal attainment, and the type of weatherization crews used. Factors controlled at the state or federal levels that influence program performance include delays in state reimbursements of local agency expenditures and local flexibility in the choice of weatherization measures. Data-gathering difficulties experienced during this project indicate a need for possible improvements in goal-setting and record-keeping procedures.

3585 **(ORNL/CON—209) Estimating balance point temperatures for residential buildings.** Sharp, T.R.; MacDonald, J.M. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001483/JAW.

This report deals with the estimates of balance point temperatures from linear regression-based models used in predicting energy use in residential buildings. The balance point temperature of a building is defined as the long-term average outdoor temperature below which the space-heating system must operate to maintain the desired indoor temperature. This balance point temperature is used in the comparison of energy use data recorded during different monitoring (i.e., climatic periods, as in evaluating retrofits, or the comparison of buildings experiencing different weather conditions. This report compares three methods for estimating balance point temperatures using both total (whole-house) and space-heating energy consumption data from seven homes. In addition, it discusses the use of linear regression models in modeling energy use and the behavior of these models and factors of influence. This report shows that the treatment of the data in energy use regression models can have significant effects on balance point temperatures. It was found that two total energy methods do not always yield estimates of balance point temperature. Although this temperature can be estimated using regression models, model parameters and standard errors may often indicate an incorrect value. This occurred for two of the five temperatures obtained when applying one of the total energy methods. Regression models of space-heating energy use on outdoor temperature provided reasonable estimates in all cases and appear to provide a more consistent basis for weather normalization through estimating the balance point than total energy use regression methods.

3586 **(PB—87-221313/XAB) Trace heating of domestic hot water pipework. Research memo.** Stephen, F.R.; Mason, C. (Electricity Council Research Centre, Capenhurst (UK)). Apr 1987. 25p. (ECRC/M—2127). NTIS, PC E04/MF E04.

When hot taps are infrequently used, the cold water residing in the distribution pipework is usually run to waste before the hot water from the storage cylinder arrives at the tap. Monitoring of hot-water systems in dwellings has shown that even where well-insulated cylinders are installed, the system efficiency is only around 50% due to energy losses in the pipework. Insulating the distribution pipework improves the system efficiency to around 70% but energy is still lost from the pipework due to intermittent usage. The application of electric trace heating to insulated pipework enables hot water to be available immediately from the tap, improves the system efficiency to around 75% and effectively doubles the volume of useful hot water available compared with a non-insulated pipework system.

3587 **(PB—87-223996/XAB) Heat transfer from pipes or electric coils in the floor.** Saastamoinen, J. (Helsinki Univ. of Technology, Espoo (Finland). Dept. of Mechanical Engineering). 29 Mar 1986. 42p. (REPT—23). NTIS, PC E03/MF A01.

The heating with electric coils and with pipes in the floor or the wall is considered in this paper. Analytical solutions for the temperature distributions are derived. The convective heat-transfer coefficient on the floor surface can be estimated from the correlations reported in the literature. The radiative part in the heat-transfer coefficient can easily be estimated with the laws of radiative heat transfer.

3588 **(PB—87-232195/XAB) Double-effect absorption heat pump. Phase 3. Final report, August 1984-December 1986.** Cook, F.B.; Cremean, S.P.; Jatana, S.C.; Johnson, R.A.; Malcosky, N.D. (Columbia Gas System Service Corp., Columbus, OH (USA)). 30 Jun 1987. 169p. NTIS, PC A08/MF A01.

See also PB—86-163722.

The RD&D program resulted in design, development, and testing of a packaged prototype double-effect generator-cycle absorption gas heat pump for the residential and small commercial markets. The 3RT heat-pump prototype demonstrated a COPc of 0.82 and a COPh of 1.65 at ARI rating conditions. The heat pump prototype includes a solid-state control system with built-in diagnostics. The absorbent/refrigerant solution thermophysical properties were completely characterized. Commercially available materials of construction were identified for all heat-pump components. A corrosion inhibitor was identified and tested in both static and dynamic environments. The safety of the heat pump was analyzed by using two analytical approaches. Pioneer Engineering estimated the factory standard cost to produce the 3RT heat pump at $1,700 at a quantity of 50,000 units/year. One United States patent was allowed covering the heat-pump technology, and two divisional applications and three Continuation-in-Park Applications were filed with the U.S.P.T.O. Corresponding patent coverage was applied for in Canada, the EEC, Australia and Japan. Testing of the prototype heat pump is continuing, as are life tests of multiple pump concepts and long-term dynamic corrosion tests. Continued development and commercialization of gas-absorption heat pumps based on this technology are recommended.

3589 **(PNL-SA—14678) Empirical characterization of residential energy use.** Stokes, G.M.; Pearson, E.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 10p. (CONF-870902—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001688/JAW.

From ICBEM '87: international congress on building energy management; Lausanne, Switzerland (28 Sep 1987).

This paper represents a general approach to analysis of electrical consumption data with relatively high temporal and end-use disaggregation. Our work differs from traditional procedures in that it is model free and relies heavily on pattern matching and classification techniques in preference to aggregation across large samples. The approach is illustrated with examples drawn from research on the thermal performance of a sample of several hundred homes in the Pacific Northwest region of the United States. 15 refs., 6 figs.

3590 **(SERI/TP—252-3145) Adiabatic air dehumidification in laminar flow desiccant matrices.** Pesaran, A.A. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 12p. (CONF-871207—14). NTIS, PC A02. Order Number DE87012268/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Adiabatic step transient heat- and mass-transfer and pressure drop experimental data were obtained for a dehumidifier test matrix that contained microbead-silica-gel desiccant in a parallel-plate geometry. The data were analyzed and compared with the results of two other test dehumidifiers: a parallel-plate matrix using crushed silica gel, and a staggered, parallel-strip matrix using microbead silica gel. The analysis showed that the overall heat- and mass-transfer Nusselt numbers of the staggered, parallel-strip matrix were about 70% to 80% larger than those of the parallel-plate matrices. It also showed that the solid-side resistance to moisture diffusion in the smaller microbead silica gel was about 45% less than that of crushed silica gel because the particle size was 60% smaller. The ratio of heat- or mass-transfer coefficient to pressure drop of the microbead-silica-gel staggered, parallel-strip matrix was higher than the other two test dehumidifiers. Based on these findings, a dehumidifier using microbead silica-gel in a staggered, parallel-strip geometry can be made more compact than the other combinations. 15 refs., 9 figs., 5 tabs.

3202 Transportation

REFER ALSO TO CITATION(S) 3641, 3644

3591 **(NP—8750148) Running and operating tests of two rotary trucks with controllable coupling of the driving masses in a DE 2500 diesel locomotive. Final technical report.** (Bundesbahn-Zentralamt, Muenchen (Germany, F.R.)). Sep 1986. 21p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750148/JAW.

A high-performance rotary truck for the speed range of 140 km/h was tested in the course of the development of the high-velocity train. The operating tests are described. The optimum solution involved passive coupling, i.e. the mechanical, speed-dependent actuation of the recoupling from rotary truck to body was replaced by passive coupling dampers of a special design. Also the disk brake design was found to be successful. Remarks are made on the definition of the coupling parameters of the driving power, the evaluation of the constructional elements, brake acceptance tests, the experimental programme, the measuring techniques, experimental procedure, evaluation, and results. (HWJ).

3592 **(OTC—87) Trucksave economy challenge 1986. Vehicle and performance data. Results.** (Ontario Ministry of Transportation and Communications, Ottawa (Canada)). 1987. 26p. (MICROLOG—87-03814). Ontario Ministry of Transportation and Communications, 1201 Wilson Ave., Downsview, Ont., Canada M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document tabulates the results of the fuel efficiency of a variety of trucks that followed premeasured routes. The trucks were categorized by weight and by type of tractor/trailer. The results are based on liters per metric tonne per 100 kilometers. On each day of the competition, a control vehicle drove the route in each direction and its performance was calculated for each route. The performance of each contestant was then adjusted by a factor derived from the control vehicle performance. That result was again adjusted by the average performance in miles per gallon over the 24 routes. This data may become useful to equipment manufacturers and the trucking industry.

3593 **(PB—87-225694/XAB) Effects of road improvement on fuel consumption of passenger buses: a case study. Technical report.** Schermers, G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Transport and Road Research). Oct 1985. 32p. (In Afrikaans). (RT—28). NTIS, PC E05/MF E05.

North American Continent sales only.

This report details the effect of road improvements on fuel consumption of two single-deck buses in the Amaotana region of Durban. It provides two regression models for estimating fuel consumption on gravel and asphalt roads. The variables included in each model are distance, time, number of passengers, and number of stops.

3594 **(PB—87-235487/XAB) Energy-management guidelines for rail-transit systems.** (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Rail Systems Center). Sep 1986. 428p. NTIS, PC E99.

Set includes PB—87-213922 through PB—87-213948.

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REFER ALSO TO CITATION(S) 3354, 3578, 4338

3595 **(AD-A—183490/2/XAB) Evaluation/selection of innovative technologies for testing with Basin F materials. Final report, July 1986-February 1987.** Balasco, A.A.; Stevens, J.I.; Lamb, T.J.; Stahr, J.J.; Woodland, L.R. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 28 Feb 1987. 39p. (ADL-REF—54148). NTIS, PC A03/MF A01.

The objectives of Task Order No. 8 to: review the industrial data base for promising hazardous-materials treatment technologies; select an ultimately evaluate the candidate technologies with laboratory testing; and prepare a preliminary process design and cost estimate for the most-promising technologies. Attention was to be directed particularly to three innovative thermal destruction technologies as typified by: in-situ vitrification; circulating-bed combustion; and glass-furnace incineration. However, other technologies that might be consider to be equally innovative were also to be evaluated. Subsequent selection and evaluation of technologies in laboratory/pilot-scale equipment was to be directed especially to the materials in Basin F at Rocky Mountain Arsenal (R MA). Based on the conceptualized flowsheets and the criteria for performance of the various technologies, it became apparent that encapsulation and high-temperature processes were the leading contenders for future evaluation in small-scale and/or pilot-plant tests.

3596 **(ANL/CNSV-TM—188, pp 3-8) Advances in anaerobic biotechnology for industrial wastewater treatment.** Speece, R.E. (Drexel Univ., Philadelphia, PA). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Applications for anaerobic biotechnology were initially in the area of food processing wastewaters. Meat packing plant wastewaters received most of the initial attention and rather simple anaerobic ponds were the most common type of unit process. The anaerobic contact process evolved from this effort. Subsequently the key role of cell immobilization was recognized and the anaerobic upflow filter, upflow anaerobic sludge blanket (UASB) and fluidized bed unit processes evolved. Recently, hybrids of these first two processes have emerged to capitalize on the positive features of each. Volumetric loading rates of approximately 2 to 4 $kg/m^3.d$ characteristic of the anaerobic contact process to 10 to 20 $kg/m^3.d$

for the UASB. One short term loading rate of 125 kg/m³.d was observed with a fluidized bed using a paper mill condensate wastewater. With the improvement in cell immobilization for unit processes for wastewaters comprised mainly of soluble organic pollutants, hydrolysis is often not rate limiting and conversion of volatile acids and hydrogen to methane becomes rate limiting. Further improvements in process efficiency may be linked to improvements in the specific activity of these classes of organisms. Laboratory studies using continuous cultures of methanogens converting acetate to methane have shown very significant stimulation resulted from supplementation with specific nutrients. The predominant population shifted from the slower growing, lower activity Methanothrix to the faster growing, higher specific activity Methanosarcina subsequent to the supplementation of iron, cobalt, nickel and trace levels of vitamin B_{12}. Generation times were reduced and acetate utilization rates were markedly increased. Acetates utilization rates of 35 kg/m³.d were noted at solids retention times of as low as 5 days. Field studies are planned to evaluate the potential benefit with two phase digestion.

3597 (ANL/CNSV-TM—188, pp 9-16) **Anaerobic treatment of pharmaceutical fermentation wastewater.** Robertson, W.M.; Green, R.E. (Abbott Labs., North Chicago, IL). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

The anaerobic degradation of pharmaceutical antibiotic fermentation wastewaters was studied at pilot scale, and a system was selected for full scale implementation. The waste contained a high proportion of suspended solids which represented about 40% of the COD, as well as residual amounts of antibiotics, extraction solvents, grain flours, sugars, protein and nutrients. Four treatment configurations were piloted: a downflow anaerobic filter, a downflow/upflow anaerobic filter, an upflow anaerobic sludge blanket, and a low rate anaerobic reactor. The high rate systems were ultimately incapable of assimilating the feed suspended solids, resulting in excessive loss of biomass and, therefore, low soluble COD removals. The low rate system adequately hydrolyzed the feed solids and yielded 70% COD and 80-90% TSS removals. The presence of antibiotic residuals did not affect the system. A full scale low rate reactor system was designed and is planned for startup in August, 1987.

3598 (ANL/CNSV-TM—188, pp 17-24) **Anaerobic treatment for pulp and paper wastewaters.** Hall, E.R.; Melcer, H.; Cornacchio, L.A.; Jones, R.M. (Wastewater Technology Centre, Burlington, Ontario). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Anaerobic technology has been gaining acceptance as a cost-effective treatment alternative for wastewaters produced in the pulp and paper industry. Potential applications for anaerobic treatment are being delineated by an extensive laboratory scale screening study of several Canadian pulp and paper wastewaters. These testing procedures estimate the level of COD and BOD removal achievable anaerobically, as well as the effects of inhibitory wastewater components on anaerobic microorganisms. Results of a pilot scale comparative assessment of several commercial anaerobic systems are reviewed along with data illustrating the effects of dynamic operating conditions on the stability of high rate anaerobic processes. The preliminary full scale process design derived from this study is also presented, with estimates of the associated capital and operating costs. In addition, a summary is provided of the other major applied anaerobic development programs in Canada. Finally, the priority ratings for applications of anaerobic technology in the pulp and paper sector are discussed along with an indication of the major unresolved technical issues associated with these applications.

3599 (ANL/CNSV-TM—188, pp 25-36) **Anaerobic wastewater treatment of a fuel ethanol facility.** Gross, R.L.; Lanting, J. (Ashland Petroleum Co., KY). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

In an effort to consistently meet an existing NPDES permit a corn to fuel grade ethanol producer in southeastern Ohio recently installed a high rate anaerobic wastewater treatment system. This plant uses the upflow sludge blanket technology to pretreat process wastewater. The effluent from the anaerobic system is polished in a two-stage bio-tower prior to discharge to the Ohio River. Included in the paper is a brief overview of the corn-to-ethanol process and a description of the types of wastewater generated. The results of a five month treatability study are presented and compared with the operation of the full scale system. Finally, the design criteria, the start-up problems, and the recent operation of the anaerobic system are discussed.

3600 (ANL/CNSV-TM—188, pp 37-50) **Microbiological aspects of anaerobic digestion.** Wilkie, A.; Colleran, E. (Univ. of Florida, Gainesville). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

This paper reviews aspects of the microbiology of anaerobic digestion and focuses on the importance of interspecies reactions in the operation and control of anaerobic reactors. The potential role of micronutrient supplementation in the selection and optimization of digester populations is discussed. The application of specific methanogenic activity test procedures, phospholipid and archaebacterial lipid analyses and methanogen immunotyping to the characterization of digester biomass is reviewed. Current microbiological approaches to the study of methanogenic biofilm and granule formation are also discussed.

3601 (ANL/CNSV-TM—188, pp 51-70) **Reactor design considerations and experiences with various wastewaters.** Jans, T.J.M.; De Mans, G. (Grontmig Consulting Engineers, De Bilt, Netherlands). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

During the last decade a great number of high-rate anaerobic treatment plants were built and put into operation for the (pre)treatment of mainly industrial wastewaters. The breakthrough in anaerobic technology for relatively diluted wastes (water content over 95%) resulted from the development and successful application of new, simple and relatively inexpensive anaerobic treatment processes. This paper discusses a selection of reactor design considerations of the upflow anaerobic sludge blanket process (UASB). This overview is based on experience with several full-scale plants presently in operation, as well as on laboratory and pilot-plant research. Finally, some project descriptions of operational reactors are presented. These descriptions discuss specific experiences encountered during start-up and operation of the reactors.

3602 (ANL/CNSV-TM—188, pp 71-80) **Anaerobic marketing - three cases in point.** Richards, E.A. (Bioenergy Systems, Ltd., Milwaukee, WI). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Described briefly are three BSL/Robex/Grontmij UASB (Upflow Anaerobic Sludge Blanket) diary industry marketing projects of the recent past, along with some problems encountered during the marketing phase. These proposed projects, in order of submission, included the following: 1. A UASB system only, releasing effluent to a large municipal plant. 2. A UASB system with a low-level aerobic post-treatment for relates of effluent to a small-town municipal plant. 3. A UASB system with high-level aerobic post-treatment to bring BOD and TSS to under 20 mgl for direct release to the environment. Along with the present status of the above three projects, some of the specific problems arising from the liability, pricing, bacteriological, and legal aspects of these types of projects are discussed, with some limited recommendation for problem approach.

3603 (ANL/CNSV-TM—188, pp 81-87) **Monsanto perspective on anaerobic treatability of industrial wastes.** Gledhill, W.E.; Valines, E.G.; Weishaar, M.F. (Monsanto Co., St. Louis, MO). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

This paper summarizes results of various research projects concerning anaerobic treatment of different Monsanto industrial waste waters. Experiences from studies that attempted to apply anaerobic technology to process effluents have resulted in no workable solutions to date. Problems of component inhibition, high total dissolved solids and low COD streams have been responsible for the lack of success. Even with the authors limited success anaerobic technology is still considered a good alternative to waste activated sludge and worth continued investigation.

3604 (ANL/CNSV-TM—188, pp 91-94) **Industrial-scale anaerobic treatment of yeast fermentation wastewater.** Johnston, D.A. (BIOTHANE Corp., Camden, NJ). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

The BIOTHANE high-rate anaerobic process has been in continuous operation at two bakers yeast manufacturing facilities for a cumulative total of nearly four years. The anaerobic system is used as a primary step in the treatment of wastewater originating from several different molasses fermentation streams. At one facility the anaerobic effluent is discharged directly to the municipality, while at the other facility the anaerobic effluent is first polished for ammonia removal in a secondary activated sludge system and then discharged to the municipality. Excellent operating results have been attained at both facilities. BOD purification efficiencies of 85% to 95% at volumetric loading rates of 10 to 14 Kg COD per cubic meter of digester volume per day are routinely achieved. This paper briefly summarizes some of the design and operating parameters for each facility.

3605 (ANL/CNSV-TM—188, pp 95-98) **Anaerobic sequencing batch reactor treatment of coal conversion wastewaters.** Earley, J.P.; Ketchum, L.H. Jr. (Univ. of Notre Dame, IN). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

This work is a continuing laboratory study to attempt development of both an operating strategy and a basis of design for Anaerobic Sequencing Batch Reactor (AnSBR) biological treatment of coal conversion wastewaters. The project is in the early stages and the results reported are based on only several moths of investigation. Support is being provided by the US Department of Energy, Pittsburgh Energy Technology Center (Grant No. DE-FG22-87PC80512). The laboratory studies are being conducted in three different size reactors. The smallest are 150-mL serum bottles that are being used to screen individual coal conversion wastewater constituents. Several constituents have been shown to be degraded under anaerobic conditions. Six 2-L AnSBR's are being operated by acclimate anaerobic sludges (i.e., organisms) to mixtures of these constituents. Finally, two automatically operated, 4-L AnSBR are being used to treat a synthetic coal conversion wastewater currently consisting of phenol, (the only carbon source) and vitamins and minerals.

3606 (ANL/CNSV-TM—188, pp 99-102) **Potential for anaerobic treatment of high sulfur wastewater in a unique upflow - fixed film - suspended growth reactor.** Love, L.S. (Sydlo, Inc., Mississauga, Ontario). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Anaerobic degradation is ideally suited for the pre-treatment of high strength industrial effluents. However, many, particularly those from the Pump and Paper Industry, may contain substantial amounts of sulfur. This will result in sulfide toxicity and inhibit anaerobic degradation. An obvious solution would be to reduce the soluble sulfide concentration within the reactor, to a point below the threshold limit. This can be done in the Sydlo Anaerobic Reactor, by rapid removal of biogas. A unique design feature, of the Sydlo Anaerobic Reactor, makes it possible to remove large volumes of supernatant including biogas containing hydrogen sulfide (H_2S), from the reactor at two intermediate points. This recycle flow, which can be very high, is directed to external gas separators, where the biogas (and H_2S) are removed. The supernatant, less biogas (and H_2S), is then returned to the reactor. The authors poster session will describe the Sydlo Anaerobic Reactor and show how it can be successfully used for the treatment of high sulfur wastewater.

3607 (ANL/CNSV-TM—188, pp 103-107) **Hiperion process: an advanced method of hydrogen sulfide removal from biogas.** Yu, J. (Ultrasystems Engineers and Constructors, Inc., Irvine, CA). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Among the bacteria responsible for anaerobic digestion of wastewater is desulfavibrio desulfurican. Sulfur-bearing compounds in wastewater streams are generally converted to hydrogen sulfide by these bacteria. Hydrogen sulfide thus produced must be removed from the biogas in order to mitigate both environmental and operational problems associated with biogas usage. In the past, the removal of hydrogen sulfide in the presence of carbon dioxide has been a difficult or expensive task. Ultrasystems Engineers and Constructors, Incorporated (Ultrasystems) has helped to develop an economical catalytic process to convert the hydrogen sulfide present in biogas to elemental sulfur. The catalyst, based on 1,4 naphthaquinone, is regenerated with air for reuse on a continuing basis. Commercial units of the Hiperion process are operational, and additional units are currently under design.

3608 (ANL/CNSV-TM—188, pp 108-111) **Dorr-Oliver's experience with anaerobic treatment of industrial wastewaters.** Sutton, P.M.; Bezler, T.W. (Dorr-Oliver, Inc., Stamford, CT). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

The Anitron system is a highly efficient anaerobic wastewater treatment process which utilizes a fluidized bed reactor. Within the reactor, a fixed-film of microbial growth (supported growth) occurs on the media (usually sand), which are hydraulically supported as a fluidized bed by the incoming wastewater and recycled effluent. Wastewaters with BOD_5 levels of 2000 mg/l or more, such as found in the food, beverage, and pulp paper industries, are candidates for treatment with this technology. Tables and a figure summarize performance results of the Anitron system with key industrial wastewaters. The Membrane Anaerobic Reactor System (MARS) wastewater treatment process represents the ultimate in biological treatment technology. A suspended growth - or contact - reactor is coupled with ultrafiltration membrane modules which serve to completely retain system biomass and provide an effluent that is essentially free of suspended solids. Candidate wastewaters include industrial streams with COD greater than 20,000 mg/1) such as cheese whey or permeate) and low flow wastewaters where conventional aerobic technology is being considered. A table indicates MARS performance results with ultra high-strength waste streams.

3609 (ANL/CNSV-TM—188, pp 112-115) **HYAN process treats high strength wastewater and generates usable energy.** Hein, D.W.; Crawford, G.V. (G.S. Processes, Inc., Scottsdale, AZ). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

The Thermal Conditioning Process at the Lakeview Water Pollution Control Plant produces a high strength waste stream that constitutes 20% of the total load of organic pollutants on the Aerobic Biological Treatment System. The Lakeview facility is a municipally owned wastewater treatment plant located in Mississauga, Ontario, Canada. In order to expand the capacity of the plant, two

options existed: either expand the aerobic treatment facility or reduce the biological load by treating the high strength wastes separately. The HYAN hybrid anaerobic process was developed to effectively treat this high strength waste and to generate a continuous and reliable supply of gas energy. The new process design has successfully overcome the problems encountered by other anaerobic systems attempting to treat high strength wastes. In particular high loading rates can now be maintained without causing either pluggage of the reactors with solids or loss of active biomass from the system. The HYAN Process is a cost effective method of treating a variety of high strength waste streams. Energy recovery, reduced operating costs, low capital costs for equipment and minimal land requirements combine to give the HYAN System a demonstrated payback that is superior to a alternative system.

3610 (ANL/CNSV-TM—188, pp 116-119) **BIOSULFIX: an anaerobic treatment process for high sulfate wastestreams and sludges.** Gillespie, G.R.; Olthof, M. (Duncan, Lagnese, and Associates, Inc., Pittsburgh, PA). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Over the past several years, attention has been focused on anaerobic treatment of high strength industrial waste streams and sludges. In this research, the presence of sulfates, sulfites, and sulfides has been considered a nuisance. In an anaerobic reactor, the sulfate reducing bacteria (SRB) reduce sulfates to sulfides that can create a toxic environment for the methane forming bacteria (MFB). The sulfides produced end up in the bio-gas formed by the anaerobic reactor. The sulfides present cause corrosion problems and odors. The work presented represents DLA's development of an anaerobic process called BIOSULFIX that degrades the organics and forms valuable by-products, mainly sodium bisulfide (NaSH).

3611 (ANL/CNSV-TM—188, pp 120-123) **Celrobic process - performance stability.** Sobkowicz, A.M. (Badger Engineers, Inc., Cambridge MA). Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

The Celrobic high-rate anaerobic treatment process was developed by the Celanese Chemical Company, and is currently being used commercially in nine installations. The upflow random packed-bed configuration accounts for the reliability and stability of the process. Its long-term continuous performance relies on the ability to measure and control the quantity of solids that remain in the reactor.

3612 (ANL/CNSV-TM—188, pp 124-127) **Anaerobic treatment of industrial wastes.** Ng, A.S.; Rose, C.M.; Torpy, M.F. Aug 1987. NTIS, PC A07/MF A01. Order Number DE88000654/JAW. (CONF-860965—).

From 2. national conference on anaerobic treatment of industrial wastewaters; Chicago, IL, USA (11 Sep 1986).

Interest in anaerobic biotechnology for the treatment of industrial wastes has grown considerably. Anaerobic biological waste treatment offers advantages over aerobic systems in terms of lower energy requirements, less biological sludge production, and the potential for energy recovery in the form of methane gas. The development of innovative reactor designs, based on the optimization of growth and retention of anaerobic microorganisms, has created an impetus to reevaluate the anaerobic treatability of many industrial waste streams. The objective of the Industrial Waste Research Laboratory (IWRL) is to examine anaerobic treatability of industrial wastes, particularly those process-wastes originating from the Organic Chemical Production Industry. Data are presented to illustrate the potential applicability of anaerobic digestion for the treatment of a wide array of industrial process-waste streams.

3613 **(BISI—23183) Refractories - production and consumption, energy matters, development.** Koltermann, M. (Metals Society, London (UK)). Feb 1986. 13p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Translated from Radex-Rundsch. 1979 (4) pp. 1120-1127.

The review presented covers production and consumption of refractories, refractory consumption in the steel industry in USA, Japan, Germany, new technology in the steel industry and the refractory market. The effect of the energy crisis, energy saving by using insulation materials, new constructional methods, increasing the consumption of unshaped products, and production of refractories with less energy are described.

3614 **(CBAC—830128) Fluoride emissions control systems and the energy efficiency of tunnel kilns. A critical review and proposed research program. Final report. Volume 1.** Joyce, I.H.; Berry, E.E. (Clay Brick Association of Canada, Toronto, Ontario). 28 Jan 1983. 99p. (MICROLOG—85-0272). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report considers the major factors involved in relation to the evolution of fluoride compounds from heavy clay products during firing, the nature of current and proposed regulations governing discharge of these emissions in Canada, the technology of control, and the likely impacts such controls might have on the energy efficiency of tunnel kilns. It is clear that the emission of fluoride containing compounds as gaseous or particulate matter from industrial sources has the potential to present some hazard to the environment in terms of: contributing to general acidic precipitation; damaging vegetation; injuring the health of foraging animals and, in extreme circumstances, the health of humans. It is also clear that the firing of heavy clay products is not, by any means, the only source of industrial fluoride, nor is it a source of such magnitude as some other industrial activities. However, as regulatory bodies seek to control industrial emissions, it is evident that some Canadian manufacturers of heavy clay products will be required to take some action to reduce the evolution of fluoride compounds from their plants.

3615 **(CCL—85) Energy conservation in the industrial mineral sector. Comminution. 3 Volumes.** (Canada Cement Lafarge Ltd., Woodstock, Ontario). 1985. 713p. (MICROLOG—85-4026). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The department of Energy, Mines and Resources CANMET, wishing to assist the industrial minerals processing sector in improving the energy efficiency of its operations and to stimulate R&D, commissioned this study. The overall objective was to develop the necessary technology to optimize the comminution of industrial minerals in terms of direct and indirect energy consumption. Ten industrial minerals were chosen for study and, to achieve the objective, the work was divided by EMR into three phases: plant studies to develop a data base, establishment of particle size monitoring methodology, and proposals for the development of pilot plant systems.

3616 **(CMS—8212) Engineering proposal for identification of underground equipment development potential and the influence of mine design.** (Canadian Mine Services Ltd.). Dec 1982. 223p. (MICROLOG—85-3425). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Supply and Services Canada has requested this proposal from Canadian Mine Services Ltd. to undertake the second phase of an in-depth study of the identification of underground equipment development potential and the influence of mine design. This project, developed by the Canada Center for Mineral and Energy Technology (CANMET), is intended ultimately to promote the further development by Canadian firms of mining equipment for the hard-rock mining industry, to improve productivity and performance, and to reduce costs of mining underground orebodies. It is expected that new techniques and equipment will not only increase safety and provide improved economies of underground hard-rock mining, but that their implementation could revolutionize the requirements for mine development, thus eliminating many existing

unit operations commonly found in underground mining. The first part of this project has been completed and consisted of a literature search and a survey of mining operations to identify the most promising areas where equipment development could influence mining operations and mine design. The second part of this project involves the analysis of potential equipment applications in hard-rock mines, based on visits to selected mines, equipment manufacturers, mining contracting firms and mines inspectorates across Canada. These site visits are the key aspect of the second phase of this project to ensure that the analysis and evaluations of the potential equipment applications are based on comments and ideas from actual mine operators who are faced daily with the tasks of hard-rock mining.

3617 **(EGG-M—23387) Oxygen enriched combustion system performance study.** Abele, A.R.; Kwan, Y.; Chen, S.L.; Silver, L.S.; Kobayashi, H. (Energy and Environmental Research Corp., Irvine, CA (USA); Union Carbide Corp., Tarrytown, NY (USA). Linde Div.; EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-8709166—2). NTIS, PC A02. Order Number DE88001500/JAW.

From Annual industry and technology conference; College Station, TX, USA (16 Sep 1987).

Objective of this study is to identify potential industrial applications for which oxygen enriched combustion systems are technically, environmentally and economically feasible and offer significant energy savings and/or productivity improvement, and then to verify the performance of selected systems in research furnaces. Tests of several commercial burner designs have been conducted at scales of 1 x 10^6 Btu/h and 10 x 10^6 Btu/h. The burners represent both conventional air fired designs and oxygen/fuel burners designed primarily for very high oxygen levels. Results of these tests indicate that over 50% fuel savings can be achieved with oxygen enrichment compared to air under certain conditions. The different burners demonstrated distinct axial wall temperature distributions which changed by varying degrees as the level of oxygen enrichment was increased. NO/sub x/ emissions increased sharply as the level of oxygen enrichment was increased for conventional air burners up to 35 to 50% oxygen. However, specially designed oxygen/fuel burners showed very low NO/sub x/ emissions for 35 to 100% oxygen. The absolute levels of the NO/sub x/ emissions also depended on the furnace temperature.

3618 **(ERP—840817) Pre-engineering assessment of an Enersolve Demonstration Project.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Energy Research Labs.). 17 Aug 1984. 44p. (MICROLOG—85-3433). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Fossil fuel used in lime kilns in kraft pulp mills in Canada totals about 350,000 cubic meters of oil per annum. There is considerable interest in the pulp and paper industry in improving the energy efficiency of the lime kiln and reducing the fossil fuel consumption and also in using fuel that originated from alternative sources to displace this fossil fuel. This report presents the results of the investigations to improve the energy efficiency and optimizatin of the lime kiln operation and outlines a multi-phase engineering plan and a program to implement the proposed modifications. A preliminary cost benefit analysis has been prepared for each major modification on the basis of capital cost and projected energy savings. 8 tabs.

3619 **(ERP/MRL—84105) The EMR small-scale flame test.** Mintz, K.J. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.). 1984. 17p. (MICROLOG—85-3406). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The small-scale flame test used by EMR since 1957 for certification of fire-resistant conveyor belting has been critcally re-examined. Some improvements in the apparatus and clarifications of the procedure are recommended. A summary of the certification experience with this test is given. One important conclusion is that the proposed elimination of the 'flowing air' component of the test would allow the passing of unacceptable belting. The tolerances required for the various parameters of the test have been estimated by a detailed study on one particular belting. These tolerances have been incorporated into the Canadian standard on fire-retardant conveyor belting.

3620 **(FE/MM—8403) Pre-engineering assessment of an Enersolve Demonstration Project. Brunswick Mining and Smelting's acid plant gas pre-heater for Supply & Services Canada.** (Fenco Engineers, Inc., Toronto, Ontario (Canada). Minerals and Metals Div.). Mar 1984. 32p. (MICROLOG—85-2547). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Fenco Engineers Inc. assessed the combustion and process efficiency aspects of the acid plant pre-heater at Brunswick Mining and Smelting as part of an energy conservation study in the Enersolve Demonstration Project series. An overall efficiency less than 50 percent was estimated for the pre-heater operation. That is, less than half the available thermal energy in the fuel is transferred to the process gases. Methods considered to improve the efficiency of operations include recycling combustion stack gases, replacing the combustion system in part or completely, using alternate fuels, and recovering additional heat from process gas exiting the acid plant. Paybacks ranged from less than one to over five years. A detailed examination of the combustion system air supply should be undertaken to determine whether savings in power can be made by simplifying the ducting. 7 tabs.

3621 **(KE—8509) Pre-engineering assessment of an Enersolve Demonstration Project for structural clay products and refractories kiln and dryer. Final report.** (Kent Engineering Ltd., Vancouver, British Columbia (Canada)). Sep 1985. 230p. (MICROLOG—86-02902). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This Department of Energy, Mines and Resources ENERSOLVE program report provides a detailed pre-engineering evaluation of the potential for cost-effective retrofit for increasing the efficiency of natural gas utilization at the heavy clay products and refractories plant of Clayburn Industries Ltd. at Abbotsford, B.C. This includes improvement of combustion efficiency, improvement of operating and maintenance procedures, and the redesign of the existing dryer or kiln. A three-phase program was recommended. Phase I was the subject of this study: process and equipment adjustments such as insulation implementation, heat recovery processes, and equipment upgrading. Results of economic evaluations of capital expenditure items are summarized. Phase II is a study and monitoring of the results of Phase I in preparation for Phase III, the installation of retrofit equipment for further fuel efficiency. A monitoring and maintenance program of the upgraded facilities will follow. 13 figs., 4 tabs.

3622 **(KE—8511) Evaluation of the potential for the application of flue gas condensing systems to gas-fired industrial boilers. Final report.** (Kent Engineering Ltd., Vancouver, British Columbia (Canada)). Nov 1985. 114p. (MICROLOG—86-04151). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Potential for application of flue gas condensation to industrial boilers usually exists where there is available a usable low temperature heat sink. The heat recoverable by a flue gas condenser is a direct function of flue gas entering temperature, moisture content of flue gas, flue gas dew point temperature, and condenser heat exchange surface area, and an inverse function of cooling water entering temperature. High excess air levels in the flue gas depress dew point temperatures and have an adverse effect on condensation of flue gas moisture and hence on heat recovery in the condenser. The development of flue gas condensation technology and equipment has progressed much further in Europe than in North America. Condensing boilers and flue gas condensers for retrofit to boilers

are readily available in Europe, whereas in North America there are few sources of supply, especially for boilers in the small to average size range. A summary of performance and economic data for the existing flue gas condensation systems at two sites are tabled. 11 figs., 8 tabs.

3623 **(KEC—8409) Pre-engineering assessment of an Enersolve Demonstration Project at Central Heat Distribution Ltd., Vancouver, British Columbia.** (Keen Engineering Co. Ltd., West Vancouver, British Columbia (Canada)). Sep 1984. 95p. (MICROLOG—85-4028). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Central Heat Distribution Limited, Vancouver, B.C., is a privately owned district heating company, regulated by the Province of British Columbia. Since 1968, one central plant, now of some 600,000 lbs/hr steaming capacity, supplies one hundred major downtown buildings through five miles of distribution piping in the Vancouver core area with steam for heating, cooling and process loads. Natural gas is the primary fuel with oil standby. The work performed in this study is comprised of combustion efficiency tests on the boilers and the considered application of individual oxygen and combustibles trim equipment to each. Load allocation contol for boiler selection-optimization is included together with consideration of the application of economizers or air heaters to two of the five boilers that are not presently so equipped. The results of testing indicate that oxygen and combustibles trim and load allocation control should be added to all boilers together wit economizers at two boilers which are not so equipped at this time. The total annual fuel savings for these additions is estimated at $160,000/year for a capital estimate of $344,000. 4 tabs.

3624 **(M—840629) Pre-engineering assessment of an Enersolve Demonstration Project at Canbra Foods Ltd., Lethbridge.** (Monenco Ltd., Calgary, Alberta (Canada)). 29 Jun 1984. 112p. (MICROLOG—85-3435). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study reviews and evaluates potential energy savings for two existing natural gas fired process steam boilers at the Canbra Foods Ltd. plant at Lethbridge, Alberta. The study includes an efficiency test of each boiler, an analysis of potential areas where efficiency might be improved and an evaluation of the major changes required to improve the overall efficiency. The parameters reviewed included the fuel quality, consumption, boiler operation and loading, amount of excess air fired, controls, and the basic condition of the existing equipment. From these operations the boiler combustion efficiencies are calculated and potential areas of improvement identified and evaluated. The report also examines projected costs of implementing the recommended modifications and monitoring subsequent performance. 4 tabs.

3625 **(MU/MMS—850117) The optimization of injection technology for high quality steel. Phase 1. Desulphurization of hot metal with calcium carbide. Final report.** Irons, G.A.; Lu, W.-K.; Chiang, L.-K. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Metallurgy and Materials Science). 17 Jan 1985. 79p. (MICROLOG—85-4576). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Forty-eight successful injections of commercial-grade calcium carbide into 2.5 Tonne heats of hot metal were carried out. The most important conditions were the type of top slag, solid to gas loading and oxygen activity. Four slag initial conditions were studied: no slag, a dry top slag (60% CaO, 40% SiO/sub 2/), a liquid slag (a commercial continuous casting powder, basicity 1.3) and the dry slag modified by pre-plunging of aluminum. The calcium carbide utilization, fraction of sulphur removed and reaction rate increased in the above order. The solid to gas loadings ranged between 15 and 160 kg/Ncubic meters, and it was found that lower loadings were beneficial to utilization, sulphur removal and reaction rate. Oxygen activity measurements showed that aluminum additions were associated with low oxygen activity and excellent desulphurization results. It is also shown that oxygen was detrimental to the plume reactions and to the top slag reactions. 23 figs., 3 tabs.

3626 **(NG—8603) Enersolve Demonstration Project. Phase No. 1. Moosehead Breweries Limited, Saint John, New Brunswick.** (Neill and Gunter Ltd., Dartmouth, Nova Scotia (Canada)). Mar 1986. 53p. (MICROLOG—86-05096). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Moosehead Breweries Limited, Saint John, New Brunswick, steam plant has three boilers. To evaluate on a continuous basis how efficiently the existing control systems operate and how well the boilers maintain the desired steam header pressure requires the alterations and upgrades to the present system. It is concluded that steam plant efficiency and operational results can be significantly improved by the installation of state-of-the-art instrumentation in the Moosehead Breweries' steam plant.

3627 **(NP—8750141) Heat exchanger application in stables.** Goebel, W.; Kohler, R.; Rist, M. (Eidgenoessische Forschungsanstalt fuer Betriebswirtschaft und Landtechnik, Taenikon (Switzerland)). Mar 1984. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750141/JAW.

Application of heat exchangers in ventilation equipment allows to make air-conditioning of stables largely independent from national-grid power supply. Various heat exchanger types were developed for stable air-conditioning. Since their efficiencies had not been fully explored, five different heat exchangers (bellow-type, foil-type, aluman-plate-type, plastic webbed-plate type, glass-tube type) were tested in both long-term and short-term measurement runs. These tests revealed that, under usual conditions, heat exchangers will allow to recover one third and more of the heat otherwise disposed of by stable ventilation in winter. The article reports on the conditions and results of the measurements performed on the different heat exchangers.

3628 **(ORF—840330) Energy conservation by chemical comminution of asbestos. Final report.** Kuntze, R.A.; Booth, C.A.; Haley, M.P.; Joyce, I.H. (Ontario Research Foundation, Mississauga (Canada). Materials Div.). 30 Mar 1984. 83p. (MICROLOG—85-0546). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A study was carried out to compare only the comminution steps with regard to energy consumption, fibre yield, and quality by processing a Canadian ore on a small batch pilot plant scale. Operational parameters such as concentration and type of surfactant as well as different comminution or separation techniques have also been examined. The fibres produced by these processing methods have been characterized by conventional test methods known in the asbestos industry, as well as by a variety of analytical techniques. The following conclusions were presented: significant energy savings are observed for wet comminution of asbestos as compared to dry comminution, fibre yield is increased significantly by employing ballmilling with a surfactant, ballmilling tends to shorten fibre (i.e. reduce the length), the use of surface active agents may have a detrimental effect on fibre properties, and multiple fibre grades may be produced by wet screening or classification. 16 figs., 16 tabs.

3629 **(ORF—850130) Literature study on energy conservation in gypsum board manufacture through reduction of the water demand of calcined gypsum. Final report.** (Ontario Research Foundation, Mississauga (Canada). Materials Div.). 30 Jan 1985. 28p. (MICROLOG—86-04398). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The production of gypsum board is an energy intensive process and increasing fuel costs have prompted manufacturers to investigate methods of reducing the energy requirements of board manufacture. This report addresses current research in energy conservation in gypsum board manufacture through reduction of

stucco water demand. The project consists of a review of published information and information obtained from the gypsum board manufacturers. A critical review of the acquired information is presented. New but unproven theories that may have potential for use in the Canadian gypsum board industry are also discussed.

3630 **(ORF—860512) Energy conservation by chemical comminution of asbestos. Phase 2. Final report (Revised).** Petrovcic, M.L.; Booth, C.A. (Ontario Research Foundation, Sheridan Park (Canada)). 12 May 1986. 92p. (MICROLOG—86-05091). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The energy survey conducted on the wet and dry processes indicated that the wet process required less energy to produce a given amount of fibre than did the dry process. Preliminary studies on the chemical comminution of asbestos had indicated that significant energy savings may be achieved using wet comminution techniques instead of the traditional dry milling operation. However, several major problems were encountered when processing ore by these new techniques. This study addresses some of these problems. The first area studied was the use of surfactants and their effect on dry milled asbestos fibre. The second task was to develop a viable wet extraction circuit capable of processing asbestos tailings material.

3631 **(PB—87-224689/XAB) Distribution of trace-element emissions from the liquid-injection incinerator Combustion Research Facility.** Lee, J.W.; Ross, R.W.; Vocque, R.H.; Lewis, J.W.; Waterland, L.R. (Acurex Corp., Jefferson, AR (USA)). Aug 1987. 57p. NTIS, PC A04/MF A01.

A series of tests was conducted at EPA's Combustion Research Facility (CRF) to investigate the fate of volatile trace elements in liquid-injection hazardous-waste incineration. In these tests, arsenic in the form of arsenic trioxide and antimony in the form of antimony trichloride were added to a methanol base containing varying amounts of chlorobenzene and carbon tetrachloride, and fired in the liquid-injection incinerator at the CRF. Test variables included incinerator temperature and excess air level, and feed chlorine content. Test results show a relatively even distribution of both elements between scrubber-exit flue gas and scrubber blowdown. Both elements are found in the vapor phase at high temperatures, though most condenses to particulate at scrubber exit temperatures. Designated POHC destruction and removal efficiency (DRE) ranged from 99.99 to 99.999% at the afterburner exit to 99.999 to 99.9999% in the scrubber-exit flue gas. Typical levels of common products of incomplete combustion were measured.

3632 **(PB—87-225140/XAB) Separate recovery of liquid and solids from ferromanganese sludge.** Maiuolo, M. (Council for Mineral Technology, Randburg (South Africa)). 29 May 1987. 21p. (MINTEK-M—185D). NTIS, PC E03/MF A01.

The sludge that results from the scrubbing of the exit gases at a ferromanganese plant was tested to show whether the liquid could be recovered and recycled to the scrubbers and the solids could be submitted to further treatment by pelletizing or briquetting before being recycled to the furnace. The particulate matter in the sludge consists of a fine condensate of metalliferous fumes with some particles of coal tar. These particles account, on average, for approximately 1 per cent of the sludge. Two methods were investigated for the separation of the liquid and solid phases: thickening followed by filtration, and centrifuging. Both methods showed that the sludge can be thickened satisfactorily to over 30% solids. A comparison is made between the capital and operating costs of several alternative methods for the dewatering and recovery of solids. Centrifuging has the lowest operating costs, but the initial capital costs are high. A procedure in which the slurry is thickened by being recycled prior to centrifuging is recommended as having the lowest capital costs. The use of binders, such as lime-molasses mixtures, pitch, and cement improved the green strength, but, when the briquettes were fired at 400 C, the compressive strength was found to be about half that of standard chromite briquettes with a lime-molasses addition of 20%. A 2% addition of cement gave similar results.

3633 **(PL—850331) Effect on the energy efficiency of tunnel kilns manufacturing structural clay products of fluoride emission control systems. Phase 2. Final report. Phase A + Phase B.** (Pollutech Ltd., Oakville, Ontario (Canada)). 31 Mar 1985. 124p. (MICROLOG—85-5926). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A technical investigation was conducted in which laboratory scale studies were used to examine means of inhibiting fluoride emissions from tunnel kilns and for brickmaking purposes. The procedures were aimed at providing possible alternatives to conventional emission control scrubbers since it was believed that scrubbers would upset thermal balances and result in energy inefficiencies. The results of the technical investigations are reported separately for Phase A and Phase B of this study. The Phase A report refers specifically to the results of the fluoride analysis on raw materials utilized in Canadian brickmaking plants, the fluoride emission profiles of selected samples under simulated plant conditions, and the development of theorized optimized firing curves for each sample tested. The Phase B report deals with the results of a literature search and experimental program to examine the efficacy of additives and fluxes in inhibiting fluoride evolution from the selected samples. The overall conclusion is that procedures utilizing firing curve control in the Phase A study cannot effectively be given serious consideration for fluoride emission control due to the high rates of fluoride emission and corresponding kiln retention times. The use of chemical additives in the Phase B experimental program clearly demonstrates that this alternative does not have a great potential as a solution to fluoride emission control at Canadian brickmaking plants.

3634 **(PL—861231) Effect on the energy efficiency of tunnel kilns manufacturing structural clay products of fluoride emission. Phase 3. Final report.** (Pollutech Ltd., Oakville, Ontario (Canada)). 31 Dec 1986. 136p. (MICROLOG—87-03998). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Phase 3 project involved the firing of test bricks under full scale and normal process conditions in four different plants utilizing tunnel kilns. Placement of test bricks across diagonal cross-sections of brick hacks facilitated a limited investigation of fluoride loss characteristics versus hack siting. Comparative effects were observed among the different raw material and additive blends comprising the test bricks. The effects of density of car packing and other process conditions were observed. Analytical comparisons were made between dried unfired and fired brick fluoride contents to yield interpretable fluoride changes. Key conclusions indicated that major factors in controlling fluoride losses were: material (with calcium content a likely control leader), car packing density and cross-section (with the lower-loss materials most affected). Recommended future work would centre on correlation between full scale process fluoride losses and a select group of cationic components (particularly calcium) in the raw materials. 1 fig., 4 tabs.

3635 **(SA—850331) Sand properties at Canadian foundries. Evaluation and measurement. Summation report.** (Shnay (Robert) and Associates Ltd., Montreal, Quebec (Canada)). 31 Mar 1985. 41p. (MICROLOG—85-4027). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The CANMET Mobile Foundry Laboratory was established to provide direct on-site technological assistance to Canadian foundries. This report outlines the procedures followed for each foundry visit. The sand testing program is described. Three distinct groups of tests were identified: control tests, analytical tests and special tests used for specific problems. Where the foundry had a sand test program, duplicate tests were done to provide a check on their procedures. The sand tests are listed and described in Appendix A. A basic progressive method of sand control is outlined in Appendix B. The major conclusion that must be drawn from this program is that there is a great need for education and training in

sand control. Foundry managers must also realize the benefits in cost reduction and productivity that are available to them.

3636 **(SNC—840518) Pre-engineering assessments of Enersolve Demonstration Projects. Final report.** van Wijlen, J.H. (SNC Group, Montreal, Quebec (Canada)). 18 May 1984. 39p. (MICROLOG—85-2546). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This pre-engineering survey is the Phase 1 of a 3-Phase Enersolve demonstration program which has as a target the conservation of energy by suggesting improvements in the operating efficiency. The Foster Wheeler oil/bark fired boiler in the Kruger newsprint mill, Trois Rivieres, was selected for investigation. This dual-fired unit offers the best potential in the steam plant for energy conservation. The following recommendations have been proposed: modification to the high pressure overfire combustion air system to improve the combustion process, installation of gas burners in air ducts to raise combustion air temperature and fitting of a small spray tip on the oil gun, updating of boiler instrumentation to improve the controls of the boiler process, replacement of the hog fuel vibrating conveyor by a more effective bark distribution system which would also reduce air infiltration into the furnace, replacement of the pneumatic hog fuel distributors by mechanical fuel spreaders to provide more even spreading of the bark on the grate, and installation of castable refractory on the inside furnace walls up to six feet high above the grate to provide a hotter combustion zone in the furnace. It has been estimated that the upgrading of the facilities would result in approximate heat savings of 3.52 million kJ/H or $165,000 per year at a cost of $770,000. A gross return of 21% would be realized on capital expenditures based on energy savings only. 1 tab.

3637 **(SNC—850715) Pre-engineering assessment of Enersolve Demonstration Project. Dairy processing plant. Final report.** (SNC Group, Montreal, Quebec (Canada)). 15 Jul 1985. 92p. (MICROLOG—87-00386). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study involved evaluation of a dairy processing plant to demonstrate energy conservation potential and developing a strategy to realize energy savings through retrofitting and revamping. The cheese and whey making plant of Agropur Cooperative Agro-Alimentaire located in Quebec was selected as a representative Canadian dairy processing plant. The pre-engineering assessment included a review of existing facility at the plant and plant operation, identification of plant equipment or process steps where substantial economic benefits would result from retrofitting and revamping, and estimation of budgetary cost for the subsequent engineering, procurement, construction management and monitoring of the retrofitted equipment. 3 figs., 2 tabs.

3638 **(SNC—860228) Evaluation of the potential for the application of flue gas condensation systems to industrial boilers. Final report.** (SNC Group, Montreal, Quebec (Canada)). 28 Feb 1986. 151p. (MICROLOG—86-03514). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The potential of applying flue gas condensing technology to large scale natural gas fired industrial boilers was evaluated in this work. The heat loss due to combustion of hydrogen in natural gas in industrial boilers is as high as 10 to 15% of the fuel energy. The flue gases are vented at temperatures in excess of 150/sup 0/C and carry recoverable energy in the form of sensible heat and the latent heat of water vapour produced by combustion of hydrogen in the fuel. The wasted energy may be reclaimed by using flue gas condensing heat recovery systems, constructed with corrosion resistant materials such as specialty steels and alloys, high temperature plastics, ceramics and high strength glass, etc. The project involved a review of flue gas condensing technology, as well as evaluation, identification, and application of commercial condensing heat recovery systems for large natural gas fired industrial boilers. The flue gases from the boiler at Domtar Fine Papers Mill, Cornwall, Ontario, were sampled and analysed. Based on these data as well as flue gas analyses, design criteria were developed for a flue gas condensing system. These were revised during later stages of the study to include changes in the energy generation circuit at the plant. 8 figs., 11 tabs.

3639 **Water chlorination Vol. 5.** Jolley, R.L. (Ed.); Bull, R.J. (Ed.); Davis, W.P. (Ed.); Katz, S.; Roberts, M.H. Chelsea, MI; Lewis Pub. (1985). 1575p. Lewis Publishers, 121 South Main St., P.O. Drawer 519, Chelsea, MI 48118.

This book describes the significant original contributions in the field of water chlorination of the last three years. It includes chlorination research, developments and alternatives. Issues covered include: water chlorination; risk; epidemiology; carcinogenic and mutagenic effects; toxicology of disinfectants; aquatic models and tumor induction; environmental effects; disinfection; reaction dynamics; chemical methods; drinking water treatment and wastewater treatment.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 3345, 3561, 3570, 3639, 4429

3640 **(APUB—E87009) Application by Northwestern Utilities Limited (Order E87009 dated at Edmonton the 10th day of February, 1987) in the matter of a general rate application, pursuant to the Public Utilities Board Act, and the Gas Utilities Act, both as amended; and in the matter of an amendment to Public Utilities Board Decision E87002 dated February 6, 1987.** (Alberta Public Utilities Board, Edmonton (Canada)). 10 Feb 1987. 4p. Public Utilities Board for the Province of Alberta, 10055-106th St., 11th Floor, Edmonton, Alta., Canada T5J 2Y2; $N/C.

This document outlines amendments made to the Public Utilities Board's decision of February 6, 1986 (E87002) approving Northwestern Utilities Limited's Revenue Requirement for the test years 1984/1985 and its General Rate Application, 1984/1985.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 3348, 3965

3641 **(CONF-8609337—) International congress on ship technology ICST 86. Conference program.** (Verein der Schiffs-Ingenieure zu Hamburg e.V. (VSIH) (Germany, F.R.)). 1986. 142p. (In German and English). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

In the course of the International Congress on Ship Technology, 6 expert lectures on the following subjects were given: Measures for improving propulsion equipment using medium-speed diesel engines; measures for increasing reliability of medium-speed engines; engine-room equipment for the ships of the future; trials of ships' main engines with brake-wheels; integrated command and monitoring systems for one-man watch and drive operation from the ship's command centre; automation concepts for the ships of the future. For each of the six papers, a separate summary of contents has been made. (HWJ).

3642 (CONF-8609337—, pp 3-47) **Measures for increasing the reliability of propulsion systems with medium-speed diesel engines.** Lochbichler, W. (M.A.N. - B und W Diesel G.m.b.H., Augsburg, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

A copiously illustrated review is given of the successes achieved in recent years with four-stroke diesel engines for ships' propulsion. The review goes into the high level of overall economic efficiency with respect to low full-consumption, a consistently low lubricating oil requirement and long service life of parts subject to wear. The report also covers the achievement of the high reliability target. The corresponding measures extended to the basic engine structure, cylinder linings, cylinder head with valves, pistons, connecting rod, injection system and charging system. By limiting the number of hydraulic tools, it was possible to achieve a particularly low level of maintenance expense, helped also by easy-opening rocker covers and fast-locks for the cylinder head. Remarks on the safety function of central cooling systems, lubricating oil systems and fuel systems are given, and the first seagoing results are reported on the mass-produced engine used in an all-purpose freighter. (HWJ).

3643 (CONF-8609337—, pp 51-75) **Measures for improvement of the reliability of medium speed propulsion plants.** Neut, L.J. (Stork-Werkspoor, Amsterdam, Netherlands). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

As a result of design measures described in detail in the article, the operational reliability of three different ship's diesel engine series was able to be substantially improved. The structural improvements presented firstly for a medium-speed four-stroke diesel engine that can be dimensioned for power outputs of between 3000 and 11000 kW, concern the turbo-charger and air coolers, the charge-air cooling system, the fuel injection system, fuel pumps, high-pressure piping, the injection holder with nozzle, injection pump drive, the injection system mounting, low-pressure piping, cylinder head and piston lining, gearbox lubrication system, gearbox countershaft to connecting rod drive, crankshaft bearings, overspeed detection, crankshaft housing and tools for servicing the engine. The paper closes with a look at systems for continuous monitoring of the operational conditions of the motor and service and maintenance of the ship's engine. (HWJ).

3644 (CONF-8609337—, pp 91-107) **Trials of ships' main engines and brake wheels.** Nolte, A. (Bremer Vulkan Schiffbau und Maschinenfabrik A.G., Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

The brake wheel is a device for the absorption of energy from propulsion systems already installed in the ship. It runs in the free water instead of an active propellor but does not develop any thrust. Many years of experience with the commissioning of ships' main engine systems with a brake wheel have shown that in many cases, this kind of trial is less expensive than trials at sea with an active propellor. After some diagrammatic outlines of the design and construction of this kind of brake wheel, its 'hydraulic' braking effect is explained, as is also the economic trials of a modern diesel-powered ship's engine system with a brake wheel. The engine output and thrust in connection with the propellor revolutions for the ship running freely and restrained by comparison with the engine limit curves, and engine output and thrust depending on the propellor speed. The overall conclusion is that the brake wheel method permits an economical trial for large ship's main engines with no risk attached. (HWJ).

3645 (NP—8770003) **Instationary operating performance of the diesel engine in generator drive.** Meyer-Adam, D. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 24 Jun 1985. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88770003/JAW.

This is an introduction to a simulation model which makes possible the calculation of the dynamic operating performance of a highly-charged, fast-running four-stroke diesel engine and its load, consisting of a generator and an electricity grid. The model was built up on the basis of a classical, mathematical statement in order to guarantee sufficient physical transparency. Measurements taken from a diesel generator assembly were used to refine and attune the simulation model and check its accuracy. The details of the description cover the diesel circuit process, flushing, isentropic compression, expansion, change of cylinder charge, compressor, turbine, the pulse model, injection pump, boost intercooling and regulator. (HWJ).

3646 (NP—8770004) **Mathematical study of the stationary and transient operational behaviour of single and dual stage supercharged Diesel engines.** Betz, A. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 17 Oct 1985. 180p. (In German). NTIS (US Sales Only), PC A09. Order Number DE88770004/JAW.

The object of this study was to extend and apply a known computer programme to the numerical, step-by-step identification of the transient operational behaviour of single-stage boosted Diesel engines. This necessitated the expansion of the mathematical regulator model to cover mechanical/hydraulic and electronic regulators for use in generator operations, and taking into account further turbine models which include the influence of the non-uniform admission of double-flow turbine casings on the group efficiency of the turbocharger, and also the possibility of two-stage boosting and making a mechanical coupling between turbocharger and crankshaft. After an introductory review of research carried out to date, the components of the mathematical model are described, as are the experimental determination of the conversion level and combustion process. The engine model is then presented, a report given on comparisons of calculations and measurements, and the effects of non-uniform admission in double-flow turbines on the transient operation of the engine and mathematical studies on instationary thermal conduction in engine components are stated. In the conclusion, the author discusses the influence of various different arrangements of the turbocharger on the operational behaviour of the generator. (HWJ).

3647 (NP—8770005) **Development of dual-component laser Doppler optics for speed measurement in a Diesel engine.** Koeller, K. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 25 Jun 1985. 79p. (In German). NTIS (US Sales Only), PC A05. Order Number DE88770005/JAW.

In order to gain a more accurate insight into the way processes work inside a combustion engine, we have to have knowledge about the chemical reactions and the reaction rate, or the flame propagation rate and flow rate field. A dual-component laser Doppler optical device was developed for the purpose of measuring such a rate field in two dimensions, and it was given practical trials in a Diesel engine. Details given cover the laser Doppler anemometry (reference beam and cross-beam method, interference fringe model, signal evaluation), the dual-component laser Doppler measuring method according to the principle of switching the direction of orientation of the fringe system (2-channel measuring with single-channel optical reception and evaluation electronics), the object being measured (technical motor specifications, vibration studies) and the measuring set-up (transmitter optics, lens and viewing window, suppression of light interference, receiver optics and electronics, particle intake). Flow rate measurements inside the piston recess are described in the conclusion. (HWJ).

3648 (NP—8770015) **Pressure measuring system for internal combustion engines with uncooled piezo-electric pressure transducer and new type of charge amplifier.** Guerich, G. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 21 Dec 1984. 250p. (In German). NTIS (US Sales Only), PC A11. Order Number DE88770015/JAW.

Pressure as a function of crankshaft angle is an important parameter for the development and monitoring of internal combustion engines. Only cooled pressure transducers were previously available for measuring such surge pressures, which are accompanied by non-steady heat flow at high temperatures. The aim of this development was to create a new uncooled pressure system and a suitable charge amplification circuit. The piezo-electric pressure transducer described precisely regarding its structure, functioning and capacity, consists of a single crystal of lithium niobiate, which was shown to resist temperatures between 25 and 550degC. The most

favourable crystal sections for optimising operation were determined and a shear type transducer was selected. The problem of prestressing was solved, so that mechanical and thermal changes of prestressing have a negligible effect on measurements. The uncertainty of measurement was 1% in the temperature range up to 250degC. The value of 0.1 Hz is given for the lower frequency limit of the charge amplifier. (HWJ).

3649 **(NP—8770017) Effect of oil filtration on the working behaviour of commercial vehicle Diesel engines. Examination of bus engines at extended intervals of oil exchange.** Tiede, H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 22 Mar 1985. 202p. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770017/JAW.

The possibilities of extending the intervals between oil changes in Diesel engines were examined. Knowledge on the effects of long intervals between oil changes on the working behaviour of Diesel engines in the conditions of using buses in local traffic was of interest here. The long period between oil changes was set at 70,000 km (or 35,000 km) for the experimental vehicles. One main point of the investigation was determining the properties of oil filter devices. The properties of shunt flow in very fine filters and comparative tests of the cleanliness behaviour of different shapes of this type of filter were examined. The tribological basis, the trends in the development of internal combustion engines, the experimental program and the results of the experiments are explained. It was found that shunt flow very fine filtration can be used, if properly applied, to control the intervals between servicing and to affect the wear behaviour of engines. (orig./HWJ).

3650 **(NP—8770018) Investigation on reducing particle emission from Diesel engine exhaust gas by particle filters.** Kroon, G. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 3 Dec 1984. 193p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88770018/JAW.

Suitable experiments were carried out in order to obtain an idea of the filtering and regeneration behaviour of uncoated and coated ceramic filters and to be able to give the first information on the behaviour of a catalytically coated steel wool filter. The effect of the particle composition on the filter effect was shown. Parameters having an effect on particle oxidation are described. There are reports on the particle emission from private car Diesel engines, particle and NO/sub x/ emission from private car and Diesel engines, treatment of exhaust gas, tasks (steady state investigation on engine test rig), the experimental program, the build-up of the test rig, analysis and results of experiments. They concern the filter behaviour (characterisation, catalytically coated steel wool filters, ceramic filters) and the regeneration behaviour (characterisation, parameters, heating, catalytic filter coating for reducing the regeneration temperature, ash in ceramic filters). There are short data on the results which are explained in the final 12 points. (HWJ).

3651 **(NP—8770019) Calculation of the transient flow field and flame propagation in the cylinder space of a spark-ignition engine.** Zarzalis, N. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemieingenieurwesen). 5 Jul 1986. 200p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88770019/JAW.

A mathematical/physical model of the flow and combustion process in a spark-ignition engine was developed which shows the field distribution of the fluidic and thermodynamic parameters at any time during a four-stroke cycle. For this purpose, the momentum, energy, and mass conservation equations were averaged in consideration of the Reynolds decomposition of the conservation parameters. Turbulence was modelled by relating the field characteristics to the averaged fluid flow parameters. Transient flame propagation was modelled by introducing a species transport equation into the fluid dynamic model. Turbulence generation was quantitatively described by examples, and the complete working cycle in zero-combustion operation as well as the transient flame propagation were modelled. An attempt was made to describe NO/sub x/ formation in terms of simple Zeldoric kinematics. (HWJ).

3652 **(PB—87-231080/XAB) Development of supercharger.** Nakamura, N.; Onaka, H.; Baika, T.; Kato, K.; Miyake, T. (Toyota Motor Co. Ltd., Aichi (Japan)). 1985. 10p. (In Japanese). NTIS, PC E06/MF A01.

Included in Toyota Engineering, Vol. 37, No. 2, 53-61(Dec 1985).

A mechanical supercharger can improve engine power and response at all engine speeds. On the other hand, the present type supercharger has a lower volumetric efficiency, a higher parastic power loss and a higher noise level. In this paper an investigation and a discussion on the above factors are described. These results lead the following conclusions: The plastic coated rotors and the proper selection of component materials increase the volumetric efficiency significantly. Declutching the supercharger and controlling the by-pass air flow eliminate the parastic power loss when boost is not necessary. The modifications of the air-outlet configuration and the gears lower the noise. The new high-performance supercharger based on these results was developed.

3653 **(PB—87-231114/XAB) Toyota Engineering, Vol. 37, No. 1, June 1987.** (Toyota Motor Co. Ltd., Aichi (Japan)). 1987. 160p. (In Japanese). NTIS, PC E07/MF A01.

See also PB—87-231122 through PB—87-231148 and PB—87-231064; Portions of this document are not fully legible.

Table of Contents includes: Development of optical combustion timing sensor; Two-hole injector improves transient performance and exhaust emissions of 4-valve engines; Development of knock-control system detecting high-frequency vibration signal; Development of CNG vehicle; Development of TOYOTA IVZ-FE type engine; Development of TOYOTA 3S-GTE type engine; Development of computer-aided design system for automobile wire-harness; Development of specialized data generator for finite-element analysis of mechanical components; Developments of new progressive power steering; Development of new type control system in the body assembly line; Introduction of heating systems for diesel engine vehicles; Transaxle and transfer for TOYOTA CELICA GT-FOUR; Development of a production control and management system for the vehicle paint shop; TOYOTA automatic guided vehicle system (AGVS); Introduction of tappet clearance-adjusting system.

3303 Electric-powered Systems

3654 **(EPRI-EM—5456) Field test of electric vehicle battery chargers: Customer and utility acceptance: Final report.** Popeck, R.A.; Tolios, K. (Detroit Edison Co., MI (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 115p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920056/JAW.

A field test was implemented to evaluate the electrical system and customer impacts of recharging up to 10 electric cars. The test was performed in a suburban community during an off-peak electricity demand period. The electrical service in this community is representative of the type of service found throughout the country. The predominant load - electric vehicle battery chargers - contained significant harmonic current distortion. The harmonic distortion was as high as 60%. Voltage distortion was also monitored, and was less than, or equal to 8%. In addition, the power factor of this load was typically less than 80%. Results of a customer response survey indicated that there were no adverse effects on their households' electrical appliances or their personal lifestyles. This report includes a description of the instrumentation suitable for harmonic measurements. Measured harmonic currents and voltages for a single charger and during the field tests are presented. Comparisons are made to existing or proposed harmonic limits for electric systems. 4 refs., 5 figs., 5 tabs.

3306 Vehicle Design Factors

3655 (NP—8770016) Heat removal from gearboxes in quasi-steady working conditions. Funck, G. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 11 Nov 1985. 210p. (In German). NTIS (US Sales Only), PC A10. Order Number DE88770016/JAW.

There are problems connected with the generation and removal of heat in the development of highly loaded gearboxes of small size. There were no heat parameters and equations before, which made the exact calculation of heat removal possible, depending on the various working parameters and design features specific to the gearbox. The aim of a very extensive experimental parameter study was to determine the following heat parameters depending on the following factors and to derive equations for calculating the total heat removal from gearboxes to the environment from them: oil, wall and ambient temperatures; geometry of heat-emitting surfaces; position of heat-emitting surfaces; material of cases and bases; flow conditions in and at the case; paint and dirt; case encapsulation; effect of the sun. Starting from the present state of knowledge on heat removal from gearboxes, there is a report on heat removal by convection and radiation, on the individual stages of experiments and calculations and on measurements on gears locally in steady working conditions. (HWJ).

3307 Emission Control

REFER ALSO TO CITATION(S) 2810, 3650

3656 (EMR/MRL—8603) Development of wire mesh particulate oxidizer traps using fuel additives for diesel emission control in mines. Kieran, F. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Mining Research Labs.). Mar 1986. vp. (MICROLOG—87-03975). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Oxidation of diesel exhaust gas and particulate emissions by filters and traps is expected to improve the atmospheres of underground mines. This paper discusses particulate oxidizer traps fabricated from steel mesh with two types of surface treatment used with and without fuel additives.

3657 (MTU—8403) A study of diesel pollutants in an underground production metal mine using an advanced monitoring and data analysis methodology. Final report. Johnson, J.H.; Carlson, D.H. (Michigan Technological Univ., Houghton (USA)). Mar 1984. 159p. (MICROLOG—85-2072). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A two-week air quality monitoring study was conducted during January 1984 in the INCO Little Stobie Underground Mine, Sudbury, Ontario. The study was part of a collaborative evaluation of LHD-mounted ceramic traps as a means of removing particulate matter from the diesel tailpipe emissions. The ceramic traps (filters) were mounted, one on each bank of the Jarvis Clark JS500 LHD vehicle exhaust system. This report addresses the research conducted for the primary purpose of assessing the effects of the filters on mine air quality. This research included daily simultaneous time-weighted-average concentration measurements for CO/sub 2/, CO, NO, NO/sub 2/, particulate matter, and SO/sub 2/ (or SO/sub 4/). Four locations were monitored. One week of measurements involved the normal INCO LHD dual exhaust system, which contained a PTX catalytic convertor on each bank. For the other week of measurements, each catalytic convertor was replaced by a ceramic filter trap. 15 figs., 8 tabs.

3658 (NP—8770009) Lube oil effects on the particle emission from diesel engines. Maurer, M. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 21 Jun 1985. 130p. (In German). NTIS (US Sales Only), PC A07. Order Number DE88770009/JAW.

The effects on the particle emission of the oil consumption at the cylinder tube and valves were determined for a free-suction, direct-injection diesel engine. The particles were characterized on the basis of their soluble fraction. Further investigations focussed on the exchange of lube oil components between exhaust gas and exhaust system. The results were as follows: At normal oil consumption, lube oil contributes little to the particle emission; higher engine loads have less effect than higher oil consumption in the cylinder and valves at lower load; the particles emitted at low load are mostly soluble; at low load, lube oil components are deposited in the exhaust system; spent lube oil contributes to the particle emission the more easily the lower its temperature; wear increases the oil consumption in the cylinders and, in consequence, the particle emissions. (HWJ).

3659 (ORF—840716) Assessment of auto-regeneration of diesel particulate filters by fuel additive(s). Final report. Vergeer, H.C.; Drummond, W. (Ontario Research Foundation, Sheridan Park (Canada)). 16 Jul 1984. 37p. (MICROLOG—85-0273). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

An evaluation of the performance of ceramic diesel particulate filters (DPF's) with manganese/copper fuel additive over a typical mining duty cycle has been completed. With fuel additive, in a concentration of 80 mg manganese and 20 mg copper per litre of diesel fuel, the filters can be expected to auto-regenerate over the cycle. The manganese/copper additive does not significantly change emissions of SO/sub 2//SO/sub 4/ and aldehydes. A substantial decrease in the Ames mutagenic activity is observed when using DPF's in combination with the fuel additive compared to uncontrolled diesel exhaust. 7 figs., 6 tabs.

3660 (ORF—860722) Completion of systems development and adaptation phase of CANMET diesel emissions reduction program. Part 3. Final report. Manicom, B.; Vergeer, H.C.; Lawson, A. (Ontario Research Foundation, Sheridan Park (Canada)). 22 Jul 1986. 78p. (MICROLOG—87-00387). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Emission control systems based on ceramic diesel particulate filters (DPFs) have reached the stage of development for practical field evaluations. Work with fuel additives and catalyzed DPFs has shown that DPFs can be regenerated under many field conditions. However, there are environmental concerns with both these methods, which are addressed by this report. Fuel additives containing manganese and manganese/copper have been used to lower regeneration temperatures to as low as 350/sup 0/C. Unaided regeneration of diesel particulate material on a ceramic DPF takes place at approximately 500/sup 0/C. This reports the final laboratory phase. 37 figs., 11 tabs.

3661 (ORF/CAFU—85-10) Completion of pre-trial phase of diesel emissions reduction option development. Phase 2. Task 1: development of an exhaust backpressure indicating system. Final report. (Ontario Research Foundation, Mississauga (Canada). Centre for Alternative Fuel Utilitzation). 19 Feb 1985. 15p. (MICROLOG—85-5929). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

An Orange Research pressure sensor/reed switch was tested for its potential use as an exhaust backpressure alarm system. This alarm system is needed as part of DPF based emission control systems to indicate excessively high engine exhaust backpressures. Laboratory and field testing showed the device to provide a workable alarm system. Some additional steps would have to be taken to protect the device when used on underground mining vehicles. However, the cost of the unit could prove prohibitively high for use in a commercial emissions control system unless substantial reductions in per unit cost could be made.

3662 **(ORF/EC—800326) Exhaust particulate filter performance study. Final report.** Chipps, K.E. (Ontario Research Foundation, Mississauga (Canada). Dept. of Environmental Chemistry). 26 Mar 1980. 45p. (MICROLOG—87-00383). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The objective of this study was to test the CANMET Filter for its performance as an exhaust particulate filter, and also to study its operational characteristics so that an assessment of its potential could be made. Testing of the CANMET Filter was done in two stages. In the first stage, the total filter, with thirteen filter sections operational, was tested. Test results were not as expected, so a second stage of testing was performed. During this second stage of testing, only six of the thirteen filter sections were left operational. Other alterations tested in this second stage were the injection of water to cool the exhaust prior to entering the filter, and removal of the filter sides to help prevent reentrainment of unfiltered exhaust into the outlet of the filter. Particulate removal efficiency of the filter averaged 42% with a range of 23%. This wide range of results was due to various filter modifications and alterations made throughout the testing program. 9 figs., 3 tabs.

3663 **(ORF/ECE—850325) Evaluation of the effects of catalyst types, engines, and load cycles on the mutagenic activity of diesel exhaust extracts.** Horton, A.J.; Lawson, A.; Belson, N.S.; Vergeer, H.; Smith, D.K. (Ontario Research Foundation, Mississauga (Canada). Environmental and Chemical Engineering Div.). 25 Mar 1985. 142p. (MICROLOG—86-03133). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The discovery of mutagenic, and by implication carcinogenic, activity of diesel exhaust particulates has caused serious concern for the underground mining industry. This has led to a requirement to identify the magnitude of this potential health hazard, and to assess possible control techniques to reduce the mutagenic activity. It is estimated that over 90% of Canadian mines, and 60% of U.S. mines, employ diesels with catalytic converters as exhaust treatment devices. Catalysts are recognized to effectively oxidize carbon monoxide and light hydrocarbons such as methane to carbon dioxide, but they also create the opportunity for oxidizing sulphur dioxide to sulphuric acid. The sulphuric acid production is a factor against the use of catalysts on underground diesel equipment. Continued use of catalysts in this regard would, however, be highly desirable if it was found that the catalyst was capable of oxidizing hydrocarbon material to the extent that it reduced mutagenic activity. The assessment of the biological activity of diesel particulates extracts using the Ames Salmonella Mutagenicity Assay has been under study in a number of laboratories. The methods developed to evaluate the mutagenic activity of diesel exhaust emissions showed good correlation between laboratory test data and the underground mine environment samples. 47 tabs.

3308 Alternative Fuels

3664 **(CONF-8611194—, pp 45, Paper 6) Natural gas as fuel in internal combustion engines.** Handrock, W. (Stadtwerke Paderborn G.m.b.H., Germany, F.R.). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

I.C. engine manufacturers and associated industries have developed and marketed methods within a short period of time which allow natural-gas-fuelled engines to be operated at low pollutivity and within the limits set by law. These methods allow both a rational and less pollutive energy supply. We may welcome the opportunity of being able to choose between several methods for pollutant abatement to match different applications; however, this versatility threatens to be lost if today's legal stipulations are to be rendered more stringent either on a regional or national level in the future. (orig./HSCH).

35 ARMS CONTROL

3665 **(AD-A—183874/7/XAB) SDIO (Strategic Defense Initiative Office) Technical Information Management Center Bibliography of unclassified reports: January-December 1985.** (Strategic Defense Initiative Organization, Washington, DC (USA)). Dec 1985. 47p. NTIS, PC A03/MF A01.

See also report for 1986, AD-A183875.

This bibliography lists to Strategic Defense Initiative Organization Technical Information Management Centers holdings of publications pertaining to such topics as Liquid Droplet Radiators, Relay Lasers, Precision-Guided Munitions, Short-Wavelength Chemical Laser, Electromagnetic Rocket Guns, Space Weapon, and Antimissile Defense Systems.

3666 **(AD-A—183875/4/XAB) SDIO (Strategic Defense Initiative Office) Technical Information Management Center Bibliography of unclassified reports: January-December 1986.** (Strategic Defense Initiative Organization, Washington, DC (USA)). Dec 1986. 69p. NTIS, PC A04/MF A01.

See also report for 1985, AD-A183874.

This bibliography lists the Strategic Defense Initiative Organization Technical Information Management Centers holdings of publications pertaining to such topics as Software Testing Measures, Digital Beamforming Arrays, Experimental Electromagnetic Launchers, Rail Guns, Artificial Intelligence, Microwave Imaging, Optical Technology, Soviet Military Power, and Soviet Laser Developments.

3667 **(AD-A—183876/2/XAB) SDIO (Strategic Defense Initiative Office) Technical Information Management Center Bibliography of unclassified books: January-December 1986.** (Strategic Defense Initiative Organization, Washington, DC (USA)). Dec 1986. 28p. NTIS, PC A03/MF A01.

This bibliography lists the Strategic Defense Initiative Organization Technical Information Management Center's holdings of publications pertaining to such topics as ballistic missile defense, arms control impact statements, beam weapons, strategic decision making, aluminum-lithium alloys, laser weapons, military space policy, and radar electronic counter countermeasures.

3668 **(UCRL—92956) Strategic defense initiative.** Sooy, W.R. (Lawrence Livermore National Lab., CA (USA)). 26 Jun 1985. Contract W-7405-ENG-48. 10p. (CONF-8411195—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE85016609/JAW.

From Annual meeting of the American Physical Society; Boston, MA, USA (1 Nov 1984).

This paper contains comments and reasons by the author on why the Strategic Defense Initiative should be implemented. (LSP)

3501 Policy, Negotiations, And Legislation

3669 **(AD-A—183764/0/XAB) Learning from experience with arms control. Final report.** Carnesale, A.; Haass, R. (Harvard Univ., Cambridge, MA (USA)). Sep 1986. 476p. NTIS, PC A21/MF A01.

This report examines the public record of nuclear arms control debates in the United States--as reflected in speeches, testimony, editorials, and other public documentation - and formulates and tests general hypotheses about arms control. Each hypothesis reflects the view of one or more important participants or constituencies in the policymaking process. The basis for analysis is provided by five case studies of negotiations and agreements; viz., the 1969 Limited Test Ban Treaty, the 1971 Accidents Measures Agreements, the 1972 SALT I ABM Treaty and Interim Agreement of Offensive Arms, the 1979 SALT II Treaty, and the 1977-1979 negotiations on anti-satellite weapons. The hypotheses deal with ten critical dimensions of arms control; importance of bargaining from strength, prospects for returning genies to their bottles, effects of unilateral restraint, linkage between arms control and other policy areas, effects of arms control on arsenals, uncertainties in estimates in the forces of the other side, verification and compliance, the lulling effect, political support, and asymmetries in American and

Soviet benefits and risks. The historical evidence generally is mixed, and only rarely can a hypothesis be demonstrated unambiguously to be either true or false. But often the weight of evidence tips the balance strongly one way or the other.

36 MATERIALS

REFER ALSO TO CITATION(S) 4021

3670 **(UCID—21203) Free Lagrange reconnection algorithms for hydrocodes using a quadrilateral mesh.** Attia, A.V. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001580/JAW.

In the dynamic response of materials to intense impulsive loading, material behavior may span both solid and fluid phases. Large relative motions may occur either because a solid fragments or because a fluid region undergoes complex motions or because of interactions at the interface between different materials. In order to address such complex motions, the computational technique should allow the mesh connectivity to vary. The Free Lagrange Method extends the classical Lagrangian continuum discretization by allowing changes in connectivity. This report covers the development of Free Lagrange reconnection algorithms for finite-difference or finite-element hydrocodes which use arbitrary mesh connectivity, but require the option to maintain a quadrilateral mesh as much as possible. Local mesh reconnection algorithms have been developed to allow general modifications to connectivity. These modifications are driven by algorithms for detecting local zone defects caused by excessive squeezing, stretching, or shearing of the mesh, such as can occur during Lagrangian simulation of large relative fluid motions. Several examples are given of the application of these algorithms for each of these types of mesh deformation. 3 refs., 34 figs.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 3154, 3161, 3198, 3365, 3365, 3381, 3381, 3389, 3442, 3466, 3625, 3737, 3738, 3785, 3822, 3852, 4062, 5172, 5287, 5291, 5298

3671 **(AD-A—183882/0/XAB) Investigation of rapidly solidified dispersion-strengthened titanium alloys. Annual report, September 1985-August 1986.** Snow, D.B. (United Technologies Research Center, East Hartford, CT (USA)). 1 Jul 1987. 103p. (UTRC/R—87-917553-2). NTIS, PC A06/MF A01.

Significant potential exists for the improvement of high-temperature strength in titanium-base alloys by the addition of rare earth elements, followed by rapid solidification and aging. To investigate this potential, the relative effectiveness with which several different rare earth elements form oxide dispersions in splat-quenched Ti-AI solid solutions was examined, using Ti-A-Er as a basis of comparison. The alloying elements of this type utilized included yttrium, lanthanum, neodymium, gadolinium, terbium, dysprosium, erbium and lutetium, added individually in amounts of approx. 0.5 at % each. Procedures were developed to prepare rapidly solidified laboratory quantities of these alloys by arc melting and splat quenching in the same apparatus, followed by aging in high-purity argon. The dispersions formed in these alloys both before and after aging at 800 C were examined and compared by analytical transmission electron microscopy. While it was not generally possible to completely suppress the precipitation of intercellular oxides by splat quenching to thicknesses of greater than 60 micrometers, in all cases most of the yttrium or the rare earth component of the alloy was retained in supersaturated solid solution.

3672 **(AERE-R—12508-Rev.) Electrochemical decontamination. Annual progress report April-December 1986.** Turner, A.D.; Junkison, A.R.; Pottinger, J.S.; Lain, M.J. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jan 1987. vp. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750123/JAW.

The aim of this work was to develop and evaluate remote electrochemical decontamination systems for metal surfaces. Decontamination factors have been determined for a range of plutonium contaminants on stainless steels, decontamination taking place by immersion electroetching using lM and 5M HNO_3 as electrolyte. Laboratory trials have identified electropolishing, in 8-10M HNO_3, as suitable for high rate decontamination and have identified design and operating features for optimizing the performance of electrolyte immersion tank decontamination. The design of a mobile decontamination unit for use in active areas has been completed. (U.K.).

3673 **(AERE-R—12620) Radiation damage simulation studies of selected austenitic and ferritic alloys. (EURATOM/UKAEA fusion technology Task MAT-12. Phase 2. April 1985-March 1987).** Walters, G.P.; Mazey, D.J.; Hanks, W.; Bolster, D.E.J.; Lurcook, D.; Sowden, B.C.; Kimber, R.I.; Murphy, S.M. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jun 1987. 80p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750646/JAW.

Results are presented of a study of the radiation damage structure of selected alloys following ion bombardment to simulate fusion-reactor exposures up to 40 dpa (approx. 3 MW-yr m^{-3}) at temperatures from 475°C-650°C. Gas concentrations appropriate to fusion-reactor conditions were simulated using a mixed gas beam of 4 MeV He + 2 MeV H_2. A beam of 46 MeV Ni ions was used in sequence with the gas beam to provide gas-to-damage ratios of 13 appM He/dpa and 52 appM H/dpa at a nickel-ion damage rate of approx. 1 dpa/hr. The materials investigated comprised three austenitic stainless steels (316L, modified 316-Ti and 316-Nb), a ferritic alloy (1.4914) and a commercial low-activation alloy containing Mn (TENELON). The results reveal that ferritic steels have good radiation damage resistance and are far superior to austenitic steels in respect of void-induced swelling.

3674 **(CEA-CONF—8859) Copper alloy surface treatment by electron beams.** Brenet, D.; Herbilleon, F.; Vinet, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). Oct 1986. 27p. (In French). (CEA-DMG—41-86; CONF-8610153—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750076/JAW.

From Autumn metallurgy meeting; Paris, France (14 Oct 1986).

A basic study on copper alloy surface fusion treatment by electron beams is presented. Geometry, microstructure and hardness evolution of transformed domains in relation to the used parameters is established.

3675 **(CEA-CONF—8986) Irradiation proposition of ferritic steels in a Russian reactor.** Seran, J.L.; Decours, J.; Levy, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Apr 1987. 6p. (In French). (CONF-8703185—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750103/JAW.

From CEA-GKAE meeting on fuel; Cadarache, France (29 Mar 1987).

Using the low temperatures of Russian reactors, a sample irradiation is proposed to study mechanical properties and swelling of martensitic steels (EM10, T91, 1.4914, HT9), ferrito-martensitic (EM12) and ferritic (F17), at temperatures lower than 400/sup 0/C.

3676 **(CEA-CONF—8989) Mechanical properties of 706 Inconel irradiated in Phenix.** Cauvin, R.; Schauff, R.; Rabouille, O. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Apr 1987. 11p. (In French). (CONF-8703185—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750104/JAW.

From CEA-GKAE meeting on fuel; Cadarache, France (29 Mar 1987).

Traction tests have been made on sheaths in INC 706 irradiated in Phenix at a maximum dose of 105 dpa F. The test results made at the irradiation temperature show an important fatigue of the material in all the temperature field: the ductility is null and the resistance sometimes reduced to 200 MPa.

3677 (CEA-CONF—8993) Application of impedance diagrams for the evaluation and the monitoring of sea water fouling. Feron, D. (CEA Centre de La Hague, 50 - Cherbourg (France)). Apr 1987. 4p. (CONF-8704217—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750462/JAW.

From European corrosion meeting (EUROCORR '87) 143. event of the European Federation of Corrosion and industrial exhibition; Karlsruhe, F.R. Germany (6 Apr 1987).

Published in summary form only.

3678 (CEA-R—5380) Study of austenitic stainless steels behaviour under creep and fatigue crack growth modes at 550/sup 0/C. Solignac, M.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Mar 1987. 190p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750116/JAW.

The behaviour of three austenitic stainless steels used for fast reactor vessels is examined under creep and fatigue crack growth modes. The behaviour of this type of material (ductile characteristic) can be described essentially by a power law (primary creep). No unique correlation can be established between creep crack growth rate and the usual load geometry parameters. An unique correlation exists between the creep crack growth initiation time and a global load geometry parameter C*/sub exp/. Time versus C* diagrams were established from the C* calculations with the semi-analytical simulations of load-point displacements, and then used for life prediction purposes in engineering applications. Under fatigue loading, the influence of experimental parameters such as frequency and R ratio has been studied as well as the effects of age hardening and cold work. The latter increases the material resistance to crack growth. A reduction in frequency and an increase in the R ratio result in increasing crack growth rate. The rupture modes of specimens were determined through metallographical examinations. The rupture was intergranular in creep tests, whilst in fatigue tests it was mixed at low Δ K values, becoming intergranular at low frequencies or transgranular at moderate frequencies. Only M/sub 23/C/sub 6/ carbides were found in these steels when tested at 550/sup 0/C. The M/sub 23/C/sub 6/ precipitation was found to be accelerated by loading. It is necessay to know the microstructural evolution in order to understand the macroscopic stainless steel behaviour.

3679 (CEA-R—5388) Experimental study of progressive buckling (compressive stress and cyclic torsion straining). Acker, D.; Clement, G.; Nicolle, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Mar 1987. 62p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750482/JAW.

Effect of cyclic deformation (thermal stresses for instance) on buckling conditions of structures loaded by a primary stress is still almost unknown. An experimental study has been undertaken on simple structures loaded simultaneously by a constant compressive stress and cyclic torsional straining. Results show clearly straining can lead progressively to buckling at compressive loads below the static critical ones, the reduction of the critical load may be considerable. 100 tests have been carried out on stainless steel 316L or copper tubes, leading or not to the collapse of the tube; the number of cycles and collapse is very different according to the combination of loadings. The experimental results are ploted on an efficiency diagramme. 12 refs.

3680 (CEA-R—5390) Surface quenched treatment by laser of Zircaloy. Richard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Mar 1987. 183p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750094/JAW.

The quenched treatment without fusion of metallic alloys can be obtained by carbon dioxide laser beam. This process implies the succession of extremely rapid thermal cycles which induce a high temperature gradient in the thickness of the material. Such treatment was applied to the surface quench of zircaloy plates and tubes. The influence of the different parameters, occurring on the quenched penetration, was studied and expressed in empiric relation. Treatments for some ten square centimeter was obtained as also a detailed characterization of the quenched structure. This one follows from a martensitic type transformation, the alpha-prime quenched phase present very small needles and an iron-chromium supersaturation without precipitates. No concentration gradient is detected in the treated thickness and no recrystallization of the underlaying metal. This process is quite suitable to thin materials and needs, nevertheless, a good control of the laser beam.

3681 (CEGB-TPRD/B—0858/R86) Development of microstructure to optimise mechanical performance of power generation equipment. Marshall, P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750228/JAW.

The factors responsible for the development of microstructure in CEGB construction ceramics and steels is assessed as a function of composition, thermomechanical treatment, thermal ageing and environmental degradation. The relationships between microstructure and mechanical properties (tensile, toughness, creep and fatigue) of relevance to structures operating in power generation equipment is then developed in quantitative terms. The conclusions from the assessment are as follows: 1. The relationship between microstructure and mechanical properties of construction ceramics and steels used in the power generation industry has been assessed. 2. Factors which significantly influence microstructure and thus mechanical properties are chemical composition, thermomechanical treatment, ageing and environmental degradation. The influence of such microstructural changes in tensile, toughness, fatigue and creep properties of ceramics and steels is assessed. 3. The benefits arising from an understanding of materials behaviour are discussed in terms of improved materials and the assessment of plant performance.

3682 (CEGB-TPRD/B—0860/R86) Effect of storage in damp air and damp argon on pond water contaminated CAGR fuel cladding steels. Simpson, P.W.G. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750229/JAW.

Retention of the mechanical integrity of fuel element assemblies during dry storage forms part of the strategy for any dry-store and is important for the ease of eventual reprocessing or disposal. This report describes a number of corrosion experiments which have been carried out on coupons of unirradiated CAGR fuel cladding steel which have been contaminated with simulated pond water. Two potential dry-store problem areas have been addressed. First is the possibility of failure of the dry-store mild steel container, allowing damp air to replace the nominally dry argon cover gas. Second is the possibility of water-logged failed fuel being inadvertently containerised giving rise to a humid argon atmosphere within the dry-store container. Specimens of niobium stabilised and titanium nitride strengthened CAGR fuel cladding steels in virgin, preoxidised and laboratory sensitised states have been exposed at temperatures of 150°C and 400°C, to air saturated with water at 10°C and to argon saturated at 25°C. Most specimens were contaminated with simulated pond water deposits containing chloride anion concentrations up to 10 ppm. No deleterious effects were observed either gravimetrically or metallographically after exposures between 10039 hours and 13152 hours. However, the absence of stress and radiation in these experiments means that caution should be exercised in applying the results to situations in which those conditions are present.

3683 (CEGB-TPRD/B—0877/R86) Interpretation of stress reductions in creep-fatigue cycles of 316 stainless steel. Hales, R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750230/JAW.

A statistical analysis of stress-drop results obtained on a number of different casts of 316 stainless steel in the temperature

range 550°C to 700°C is presented. In all cases the results were obtained from strain controlled fatigue tests. The equations used to describe stress relaxation here are derived from forward creep equations which describe the dependence of creep rate on time, stress and temperature. Although there is no clear correspondence between creep and stress relaxation, creep equations offer an attractive starting point. Not all the models considered exhibited the expected response to changes in temperature. A revised analysis was carried out on the assumption that stress relaxation is thermally activated according to the Arrhenius equation. Two models were found to fit the data equally well and it was not possible to choose which of these relationships is the more appropriate to describe stress relaxation of cyclically conditioned material. On the basis of the evidence both are acceptable and may be used to calculate the creep damage according to the various high temperature design codes. Whichever gives the more conservative assessment should be used until a more mechanistically based judgement can be reached.

3684 **(CNEA-NT—2/82) /sup 51/Cr diffusion in Zr-Sn alloys.** Nicolai, L.I.; Migoni, R.L.; Hojvat de Tendler, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1982. 39p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700006/JAW.

The /sup 51/Cr volume diffusion in Zr-Sn alloys is measured in polycrystals with big grains by the thin-film method. The Sn content in the alloys ranges from 0.39% at to 6.66 % at. In the beta-phase the analysed temperature range is 982 deg C-1240 deg C. The Sn dehances the /sup 51/Cr diffusion in beta-Zr, the effect being small but well defined. Assuming the formation of Sn-Cr dimers, the linear dehancement coefficient b and the parameters for the variation of b with temperature were calculated. The parameters Q and D/sub o/ were calculated for the more diluted alloys and, upon application of the Zener theory for D/sub o/, a negative contribution to the activation entropy is found. Three experiments at different temperatures were performed in the alpha-phase. /sup 51/Cr diffuses very fast in alpha-Zr-Sn. No definite correlation is found between the /sup 51/Cr diffusivity and the increasing Sn concentration, probably due to the anisotropy of the alfa-phase. (M.E.L.).

3685 **(CONF-850679—5) Precracking and computerized single-specimen J/sub Ic/ determination for irradiated three-point bend specimens.** Haggag, F.M.; Richardson, A.K. (Oak Ridge National Lab., TN (USA); Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1985. Contract AC05-84OR21400;AC07-76ID01570. 8p. NTIS, PC A02. Order Number DE88001422/JAW.

From 18. American Society for Testing and Materials symposium; Boulder, CO, USA (1 Jun 1985).

An experimental procedure is described for precracking and computerized single-specimen J/sub Ic/ testing of irradiated three-point bend specimens. The specimens were automatically precracked in cantilever bending at constant deflection. The J/sub Ic/ values determined by the single-specimen unloading compliance technique were found to be in close agreement with multiple-specimen values. The J/sub Ic/ testing system comprised a three-point bend fixture and a furnace mounted on a screw-driven Instron testing machine, a Hewlett-Packard computer, and a data acquisition system. This procedure was found to be successful and cost effective in precracking and J/sub Ic/ testing of the irradiated specimens. 7 refs., 12 figs.

3686 **(CONF-870839—5) Microstructural characterization of irradiated Fe-Cu-Ni-P model steels.** Miller, M.K.; Hoelzer, D.T.; Ebrahimi, F.; Hawthorne, J.R.; Burke, M.G. (Oak Ridge National Lab., TN (USA); Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering; Materials Engineering Associates, Inc., Lanham, MD (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. Order Number DE88000573/JAW.

From 3. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Traverse City, MI, USA (30 Aug 1987).

The microstructure of Fe-Cu-Ni-P model pressure vessel steels after neutron irradiation and thermal aging has been characterized by atom probe field-ion microscopy and augmented by transmission electron microscopy. High densities of small, roughly spherical or disc shaped copper clusters/precipitates were observed in the neutron irradiated alloys that contained copper. Small spherical phosphorus clusters were observed in the irradiated copper-free alloys, and copper phosphides were observed in a high phosphorus Fe-Cu-Ni-P alloy. None of these clusters/precipitates were observed in the thermally aged materials. The increases in the tensile and yield strengths that were observed after neutron irradiation resulted from these clusters and other lattice defects. 14 refs., 8 figs., 2 tabs.

3687 **(CONF-8709135—3) Soft x-ray emission spectra and the bonding of aluminum.** Callcott, T.A.; Tsang, K.L.; Zhang, C.H.; Ederer, D.L.; Arakawa, E.T. (Tennessee Univ., Knoxville (USA); National Bureau of Standards, Washington, DC (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88000591/JAW.

From 14. international conference on X-ray and inner-shell processes; Paris, France (14 Sep 1987).

The L/sub 2,3/ soft x-ray emission (SXE) spectra of Al in metallic Al, Al-Mn alloys, dilute Al-Mg alloys, the intermetallic compounds LiAl and Ni_3Al, the semiconducting alloy (Al-Ga)As and insulating Al_2O_3 are presented. The spectra provide a measure of the s-like partial density of states (PDOS) localized at the Al atoms and show prominent qualitative features that may be identified with each of the major types of bonding in solids, i.e., metallic, covalent and ionic. The spectra of metallic Al and of the Al-Mn alloys have parabolic densities of states characteristic of nearly free electron PDOS's. Al in Mg alloys have metallic PDOS's with a strong enhancement of the low energy region of the spectrum which is associated with screening of the extra charge on the Al ion core. In LiAl, the Al has tetragonal local symmetry, the spectrum is similar to that of silicon, and the bonding is a combination of covalent and metallic. In Al/sub x/Ga/sub 1-x/As alloys, the Al has tetragonal local symmetry, but the spectrum is strongly modified from the characteristic covalent form by the presence of a strong ionic component in the bonding. Finally, the spectrum of Al_2O_3 shows features characteristic of localized electronic orbitals and ionic bonding. 15 refs., 6 figs.

3688 **(CONF-8709144—1) Advances in processing techniques for nickel aluminides.** Sikka, V.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014571/JAW.

From ASM Europe technical conference on advanced materials and processing techniques for structural applications; Paris, France (7 Sep 1987).

The status of processing technology at ORNL for three nickel aluminide alloys is presented in the form of flow charts. The technologies discussed include powder processing, melting techniques, near-net-shape processes from molten metal, and cold and hot working of cast products. Tensile properties are compared for one of the three alloys after six different processing techniques. Creep-rupture strength is compared for the three nickel aluminide alloys in the cast and wrought condition. Grain size was the main difference between the material produced by various processing techniques. Significant advances in processing technology of nickel aluminides could find them in use for a range of applications in the future. 7 refs., 9 figs., 2 tabs.

3689 **(DOE/ER/13017—4) Study of interactional effects in the chemisorbed layer by Infrared Reflection Absorption Spectroscopy (IRAS): Progress report for period April 1, 1986-March 31, 1987.** Yates, J.T. Jr. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). Oct 1987. Contract AC02-82ER13017. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001808/JAW.

The IRAS (Infrared Reflection Absorption Spectroscopy) method has been applied to the study of CO adsorption on Ni(111). Evidence has been found for the coexistence of two-fold and three-fold coordinated CO species at low CO coverages. A continuous coverage-dependent conversion from three-fold to two-fold bridged CO has been observed. Accurate correlation of the development of the IRAS spectra with CO coverage, with CO temperature pro-

grammed desorption behavior, and with LEED behavior has been established through studies of the frequency and lineshape of the spectral features. Evidence for inhomogeneous CO layers at the highest CO coverages was obtained. This work establishes baseline behavior for other IRAS studies of this system to be reported. 23 refs., 6 figs.

3690 **(DOE/ER/45142—6) Very low temperature studies of hyperfine effects in metals: Progress report, [1987].** Weyhmann, W. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). May 1987. Contract FG02-84ER45142. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001546/JAW.

Goal of the program was to make new investigations on the nuclear magnetic ordering transition at 2.5 mK of the hyperfine-enhanced coolant $PrCu_6$ in polycrystalline form and complete thereby a survey of its important magnetic and thermodynamic properties at this transition. Proposed was extending the work to $PrNi_5$ (T/sub c/ ≅ 0.5 mK), to single crystal material where available, and to La or Y diluted materials to form nuclear spin glasses. Proposed are also additional efforts on the Kondo effect and itinerant ferromagnets as time allowed. We designed a dilatometer and are obtaining good data in (magnetostriction). 1 fig.

3691 **(DP-MS—87-91) Fractographic and microstructural aspects of fracture toughness testing in irradiated 304 stainless steel.** Cullen, W.H.; Hiser, A.L.; Hawthorne, J.R.; Abramczyk, G.A.; Caskey, G.R. (Materials Engineering Associates, Inc., Lanham, MD (USA); Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 32p. (CONF-871207—19; MEA—2245). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000795/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Fracture toughness and Charpy impact test results on 304 stainless steel baseplate, weld and heat-affected zone (HAZ) tested at 25°C and 125°C are correlated with the microstructural and fractographic features observed in these materials. Specimens were collected from several sections of 12.7 mm (0.5 in.) wall thickness piping removed from a process system, and were characterized by different material chemistries and thermomechanical histories. As a result, mechanical properties vary over a considerable range from one pipe section to another. The presence of delta ferrite in some of the samples caused significant degradations in the toughness properties for certain crack orientations. Decreases in Charpy impact energies occur in the same material for different crack orientations. Materials irradiated showed 40% decreases in Charpy impact energy, but little change in fracture morphology. An increase in the test temperature resulted in an expected increase in Charpy energies for all materials. Fractographic features did not change appreciably with respect to the 100°C increase in test temperature. In unirradiated specimens, a test temperature increase caused lower J/sub Ic/ and J-R curve values with tearing modules values increased. The latter is due to the large decreases in tensile strength with increasing test temperature. The weld metals tend to have the highest tearing resistance, while the HAZ's tend to have the lowest. 30 figs., 3 tabs.

3692 **(EGG-M—10187) Auger electron spectroscopy and x-ray photoelectron spectroscopy of the biocorrosion of copper by Gum Arabic, BCS and Pseudomonas atlantica exopolymer.** Jolley, J.G.; Geesey, G.G.; Hankins, M.R.; Wright, R.B.; Wichlacz, P.L. (EG and G Idaho, Inc., Idaho Falls (USA); California State Univ., Long Beach (USA). Dept. of Microbiology). 1987. Contract AC07-76ID01570. 14p. (CONF-8706216—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014871/JAW.

From 9. symposium on applied surface analysis; Dayton, OH, USA (5 Jun 1987).

Thin films (3.4 nm) of copper on germanium substrates were exposed to 10% Gum Arabic aqueous solution, 1% BCS (aqueous and simulated sea water solutions) and 0.5% Pseudomonas atlantica exopolymer (aqueous and simulated sea water solutions). Pre- and post-exposure characterization were done by Auger electron spectroscopy and x-ray photoelectron spectroscopy. Ancillary graphite furnace atomic absorption spectroscopy was used to monitor the removal process of the copper thin film from the germanium substrate. Results indicate that the copper was oxidized by the Gum Arabic and BCS, and some was removed from the Cu/Ge interface by all three polymers and incorporated into the polymer matrix. Thus biocorrosion of copper was exhibited by the Gum Arabic, BCS and Pseudomonas atlantica exopolymer. 14 refs., 4 figs., 3 tabs.

3693 **(EGG-M—27186) Tensile properties of extrusion consolidated Type 304 SS rapidly solidified powders.** Flinn, J.E.; Korth, G.E.; Wright, R.N. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 25p. (CONF-861063—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014875/JAW.

From American Society of Metals materials week; Lake Buena Vista, FL, USA (6 Oct 1986).

Rapidly solidified Type 304 SS powders prepared by centrifugal atomization (CA) using helium as a quench gas and having a dendritic microstructure were hot extruded, resulting in fully consolidated bars with a recrystallized fine grain size. The extruded bar, as well as the powder, contained 8 appM of entrapped helium acquired during powder processing. Prior to tensile testing, the specimens were given various preconditioning heat treatments (PCHTs). The tests were conducted in air over a temperature range of 24 to 800°C at a strain rate of approximately 10^{-4}/s. The tensile properties of the CA 304 SS extruded powders were compared to an ingot metallurgy (I/M) Type 304 SS material with a similar chemistry. The tensile strengths and reductions in area were superior for the powders, compared to the I/M material, but uniform and total elongations were slightly lower. There were no obvious helium influences associated with the ductilities, e.g., embrittlement. The preconditioning heat treatments for the powder specimens had a significant influence on the strength properties. Strengthening mechanisms are discussed, including grain size, entrapped helium influences and apparent carbide effects. 6 refs., 14 figs., 1 tab.

3694 **(EPRI-NP—5399) High-purity steels for utility components: Final report.** Ohhashi, T.; Bodnar, R.L.; Reemsnyder, H.S.; Steigerwalt, R.E. (Japan Steel Works Ltd., Muroran, Hokkaido; Bethlehem Steel Corp., PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 302p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920035/JAW.

Four structural steels commonly used for utility components like rotor forgings and pressure vessels have been evaluated in high-purity form with levels of manganese and silicon ranging from zero to conventional levels. When manganese is absent from the high-purity steels, it is found to be desirable to compensate for decreased hardenability by increasing the remaining alloy content. The main benefits of improved purity and low Mn and Si content have been found to be increased fracture toughness, reduced fracture appearance transition temperature (FATT), and improved resistance to temper embrittlement. Some improvement in creep rupture ductility was found to be associated with low Si and Mn contents. Reduced volume fraction of inclusions, mainly sulfides and silicates associated with manganese and silicon, are responsible for the observed improved toughness and ductility characteristics. Transformation (CCT curves), cleanliness, tensile, FATT, creep rupture, and fatigue characteristics were observed on the steels studied. 68 refs., 173 figs., 82 tabs.

3695 **(EPRI-NP—5409) Automatic sizing of intergranular stress corrosion cracking with IntraSpect/98: Topical report.** Sasahara, T. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 30p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88920036/JAW.

A procedure for IGSCC sizing using the IntraSpect/98 automated pipe inspection system was developed and was used to pass the NDE Center's IGSCC sizing qualification examination. Sizing techniques using three different ultrasonic transducers, including shear wave, creeping wave, and multiple beam search units, were developed and tested on the NDE Center's IGSCC practice sizing samples prior to taking the qualification examination. The qualification examination was passed a second time after the procedure was modified to include a fourth transducer to increase the sizing accuracy. The creeping-wave search units produced reliable results for

deep cracks. For some cracks, the shear wave examination was unsatisfactory because of a low signal-to-noise ratio. The multiple-beam technique was reliable and accurately measured the crack depths. 6 refs., 11 figs.

3696 **(ERATL—87/28/XAB) Likely impact of neodymium-iron-boron materials on permanent magnet users and producers.** Hamdi, E.S. (ERA Technology Ltd., Leatherhead (UK)). May 1986. 38p. (ERA—86-0048R). NTIS $96.00.

The report is based on the Gorham Second International Conference on the impact of neodymium-iron-boron (Nd-Fe-B) materials on permanent-magnet users and producers, which was held in Florida, USA, on 24 March 1986. The report discusses the availability of neodymium and methods of producing the metal and magnet alloys. The available techniques to process Nd-Fe-B magnets, and the properties of the various commercially available magnets are reviewed. Finally, the report considers the extent to which these magnets will replace other magnet types, and concludes that such replacement will be large and widespread.

3697 **(ERATL—87/38/XAB) Giant magnetostrictive alloys.** Lockwood, M. (ERA Technology Ltd., Leatherhead (UK)). Sep 1986. 33p. (ERA—86-0182R). NTIS $64.00.

Recent research in the USA has resulted in the development of a class of alloys displaying significant magnetostrictive effects. The alloys are based mainly on terbium, dysprosium, and iron. The technology has progressed to the point where commercial production of the alloys is feasible. The availability of the material is described in terms of the present and near future. Longer-term constraints on availability are also discussed. The effects of raw-material supply and processing costs are important factors influencing the potential market penetration of the alloys. Current techniques used in the preparation of the alloys are based on experience and so called green finger techniques. Significant improvement seems possible by automating the preparation processes.

3698 **(EUR—10773-IT) Continuously cast eutectoid wire rod steels: Final report, May 1, 1982-October 31, 1985.** Mascanzoni, A.; Stampa, E.; Crispoldi, G.; Chesi, G. (Centro Sperimentale Metallurgico, Rome (Italy); Deltasider S.p.A., Piombino (Italy)). 1986. 111p. (In Italian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900074/JAW.

This study concentrated on the development of steels of new composition which ensure higher strength levels on wire rod and drawn wire while maintaining the fine pearlite structure, suitable for direct drawing. The experiment concerned two principal lines of activity: a metallurgical study of the effect of appropriate alloy elements (mainly Si, Cr and V) on the microstructure and mechanical properties of the high-C steel, and a systematic investigation of the effect of the main process parameters (superheat temperature during continuous casting, heat treatment temperature of blooms and billets, and cooling rate of wire rod on Stelmor conveyor) on which depends the quality of the commercial product (with particular reference to the control of axial segregation, mechanical strength and ductility of the wire rod. Analytical expressions were derived which explain how the main microstructure parameters control the mechanical properties of pearlitic steels. Local carbon concentration limits were defined which ensure there is no formation of brittle structure (intergranular cementite) in the segregated zones. A steel of new composition (low-C, Si-Cr) was tried on industrial scale with promising results as regards both wire rod and drawn product. 28 refs., 27 figs., 16 tabs.

3699 **(FEI—1721) Internal friction of fast neutron irradiated monocrystalline niobium and thermal stability of radiation-induced effects.** Zakharova, M.I.; Artemov, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700326/JAW.

Spectra of internal friction of monocrystalline niobium of different orientations after the fast neutron irradiation up to 1.14 x 10/sup 26/ neutr./m/sup 2/ fluence and isochronous annealings in temperature range of 573-1973 K have been studied. Activation energy values for relaxation processes have been determined. The interaction of introduction impurity atoms and radiation-induced defects has been investigated, binding energy of the complex: introduction impurity atom - radiation-induced defect has been evaluated, boundaries of radiation-indued defect thermal stability have been determined. Possible mechanisms realizing in bcc lattice metals under irradiation are discussed. 11 refs.; 9 figs.; 1 tab.

3700 **(FhG-IzfP—850148-TW) Nondestructive magnetic testing of laser hardening parameters (hardening depth, hardness profile, retained austenite). Final report.** Kern, R.; Theiner, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). 1986. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750017/JAW.

Because of the increasing commercial use of high power lasers for surface annealing treatments, a nondestructive test to improve the production quality and reliability is required. Therefore our aim is the development of a nondestructive testing method to determine the fundamental hardening parameters hardness, hardening depth and retained austenite in CK45. The two micromagnetic methods magnetic Barkhausen noise and incremental permeability and derived quantities e.g. the maximum amplitude of the Barkhausen noise or the coercivity are appropriate to determine the above material parameters. With 18 refs., 1 tab., 32 figs.

3701 **(GKSS—87/E/19) Finite element analysis for calculation of calibration curves of fracture mechanics specimens with semicircular surface cracks of various incipient crack depths, for crack depth measurement using the direct current potential crack monitoring method.** Dietrich, R.; Schoenfeld, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 21p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750026/JAW.

The finite element method is used to calculate the calibration curves which are required for the electrical direct-current potential crack-monitoring systems, as applied to fracture mechanics specimens with thickness B = 5 mm, 10 mm, 15 mm, 18 mm and 20 mm. The starting crack is a/sub 0/ = 0.1 B for all specimens. With 11 figs.

3702 **(IAE—4325/11) Evolution of radiation-induced voids and dislocations at low temperature.** Turchin, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700350/JAW.

Evolution of the set of vacancy loops (VL) generated in cascades of successive collisions of metal atoms (austenitic steels and alloys) during neutron and ion irradiation is studied analytically. It is shown that VL play the determining role in the development of radiation damage at a low temperature. Expression for the function of VL distribution over sizes is obtained, regularities of its development in time, taking into account other defects, are investigated. VL effect on swelling is determined. It is shown that the presence of low-temperature boundary of swelling and its displacement with the change in atom shift rate can be explained by the formation of VL sets. 16 refs.; 2 figs.

3703 **(IAE—4332/11) Investigation of impurity defects in α-iron by molecular dynamics method.** Kevorkyan, Yu.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700355/JAW.

Investigation of the configuration of impurity defects in α-iron by the molecular dynamics method is presented. The Jhonson model potential has been used to calculate the interaction of matrix atoms. The impurity-matrix atom interaction is described by the same form of the potential shifted along the axis of interatomic distances for a definite value. The correspondence between the shift value and change in the radius of the impurity defect is established

on the basis of calculation of the relaxation volume. Possible configurations of the impurity - interstitial matrix atom complexes are obtained for the given model of the impurity defect, dimensional boundaries of possible transitions between different configurations are determined. Formation and bound energies, relaxation volumes of impurity defects are calculated. 11 refs.; 1 fig.; 2 tabs.

3704 **(Juel—2109) Selected experimental activities of the Institute for Reactor Development. Colloquium on the occasion of the 60th birthday of Professor Dr. Rudolf Hecker.** Filges, D.; Stoever, D. (comp.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Dec 1986. 80p. (In German and English). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750024/JAW.

On the occasion of the 60th birthday of Professor Dr. Rudolf Hecker, director at the Institute for Reactor Development, the staff members of the institute arranged a discourse about current research items. On September 9, 1986, dedicated review talks were presented summarizing the aims of the new research program of the institute. This research is mainly based upon wide earlier experience in high temperature reactor physics and technology, fusion research and spallation physics. The presentations comprised on one side talks about protective layer development and hot isostatic pressing within newly established materials research program of KFA, on the other side talks were presented about high-energy beam materials interaction dealing mainly with computer simulation of particle cascades in matter and their validation by experiments.

3705 **(Juel—2120) Quantitative electron probe microanalysis investigation of the oxidation of high temperature alloys at low oxygen partial pressures.** Maldonado Lopez, L.A.; Gruebmeier, H.; Naoumidis, A.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.)). Mar 1987. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750021/JAW.

Dissertation. Submitted by L.A. Maldonado Lopez.

Using electron probe microanalysis techniques, the oxidation of two high temperature alloys (alloy 617 and alloy 800 H) has been investigated. Specimens were exposed for up to 5000 h in a simulated methane reformer gas environment in the temperature range 800 to 950/sup 0/C. Oxygen partial pressures were in the range 10/sup -19/ to 10/sup -16/ bar. In the investigation, particular attention was given to the determination of quantitative data for the oxide scales formed at the surface, the analysis of minor elements in the scale and the depletion effects in the matrix immediately below the scale. The oxide scale formed on alloy 800 H was found to comprise two layers, an outer layer containing Mn/sub (1+x)/Cr/sub 2(1-x)/Ti/sub x/O/sub 4/ (spinel) and MnTiO/sub 3/ (Ilmenite type) and an inner layer of Cr/sub 2-y/Ti/sub y/O/sub 3/ where $0.05<y<0.07$. The specimens of alloy 617 formed mainly single phase scales consisting of Cr/sub 2-y/Ti/sub y/O/sub 3/. Concentration profiles in the sub-surface regions for the constituent elements were measured and used to determine the mass flow at the surface in mg cm/sup -2/. The mass flow was then incorporated as a boundary condition in a diffusion program for calculation of the concentration profile. The program allowed derivation of the diffusion coefficients of Cr, Mn and Ti, and the values obtained were in good agreement with those published in the literature. It was found that the dissolution of chromium carbides in the near-surface regions caused by depletion of chromium to form the scale contributed up to 50% of the chromium consumed in oxidation in alloy 617. In alloy 800 H, the contribution was significantly lower.

3706 **(Juel—2124) Experiments to determine the kinetics of the growths rate of oxide scales on high temperature alloys in the range of medium oxygen pressures.** Kraehling, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Apr 1987. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750187/JAW.

The oxidation of high temperature alloys will be studied at temperatures of 750degC-960degC and oxygen pressures in the range of 10/sup -20/ bar $<$ P/sub 02/ $<$ 1 bar using a microbalance. Up to 800degC the oxide growth is parabolic while above this temperature the evaporation of chromium oxide becomes more and more important. It will be shown that the chromium concentration at the metal-oxid-interface is constant with time although a clear concentration profile can be measured in the alloy.

3707 **(KFK—4205) About the correlation between microstructure and thermomechanical properties of two-phase materials and porous sintered materials.** Ondracek, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Mar 1987. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750019/JAW.

English version published in Mater. Chem. Phys. (1986) Vol. 15.

The paper basically deals with the aim, to get a better scientific insight into the effects of microstructure and properties of multi-phase and porous materials and to use the results technologically for tailoring those materials. First the theory of microstructure-property correlations including both, the bound concept and the model concept, is described using conductivity and Youngs modulus of elasticity as property examples. Since in the frame of theoretical derivation no fitting factors have been permitted to be introduced into the bound equations and constitutive equations the determination of the microstructural factors by quantitative microstructural analysis is demonstrated in the second part of the contribution. By comparing measured and calculated property values for porous ceramics, graphite and metals as well as cermets, metal-polymer and polymer-ceramic-composites the equations are tested for engineering conditions. Finally the dependences of the thermal conductivity and Youngs modulus of elasticity on porosity are used to predict the thermal shock resistance of porous glass and to compare the results with experimental values. (orig./IHOE).

3708 **(KFK—4263) Properties of Nb/sub 3/Sn superconductor wires with composite cores.** Gauss, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). May 1987. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750028/JAW.

In order to increase the pinning forces, Nb/sub 3/Sn wires with filaments containing normalconducting inclusions were produced. The classical alloyed cores produced by melting were replaced by powdermetallurgical ones consisting of mixtures from Nb and X powders (X = Ta, Ti, Ni, NbTi) which were pressed, extruded and processed to rods. The further processing for 19 core wires was made by the bronze route. Finally, the wires were reacted for 64-120 h at temperatures between 625degC and 750degC. Depending on the reaction temperature, a smaller or larger amount of the addition element dissolves in the superconducting A15 phase. By optimizing the reaction conditions, an envelope above classical binary and ternary J/sub c/ vs B curves could be achieved, with simultaneously excellent current carrying capacity at low and high fields. In the region of 11-12 T (crossover for classical processed wires) the increase of wires with 'artificial' pinning centers with respect to classical ones is about 70%. The results were discussed by means of the current theories.

3709 **(LBL—23879) Microstructural observations of the Sn-Pb solder/Cu system and thermal fatigue of the solder joint.** Frear, D.R. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001392/JAW.

This study was performed in order to understand the microstructural mechanisms that lead to solder joint failures in thermal fatigue. The solders studied were 5Sn-95Pb and 60Sn-40Pb joined to Cu. The precipitation process of β-Sn in 5Sn-95Pb was fully characterized. On fast cooling from single phase α-Pb the Sn precipitates homogeneously. On slow cooling the precipitation process is cellular. The 60Sn-40Pb had a two phase microstructure. The Sn-rich phase was interconnected and polygranular. Both phases, and Sn grains, coarsened with time at 125°C. Coarsened 60Sn-40Pb microstructure was deleterious to the mechanical properties. Failures

initiated and propagated through interfacial intermetallics only at extremely fast strain rates. Interfacial intermetallics had no influence on thermal fatigue properties. Cu_6Sn_5 eta-phase whiskers formed at the intermetallic solder interface. Thermal cycling tests were performed on both joints using a -55°C to 125°C cycle and 19% imposed shear strain. Failures in 5Sn-95Pb occurred at Pb grain boundaries. Isothermal fatigue tests on 5Sn-95Pb give similar results. A heterogeneously coarsened region of both Pb and Sn-rich phases develops within the 60Sn-40Pb solder joints. Cracks initiate and propagate through the heterogeneously coarsened region. Heterogeneous coarsening and failure occurs in high and low thermal cycles. Isothermal fatigue cannot be compared to thermal fatigue results of 60Sn-40Pb on Cu. 115 refs., 105 figs., 5 tabs.

3710 **(LYCEN—8611) Physical and chemical characterization of surfaces of nitrogen implanted steels.** Moncoffre, N. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Jan 1986. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750255/JAW.

The studied steels are of industrial type (42CD4, 100C6, Z200C13). Very often, the low carbon steel XCO6 has been used as a reference material. The aim of the research is to understand and to explain the mechanisms of wear resistance to improvement. A good characterization of the implanted layer is thus necessary. It implies to establish the distribution profiles of the implanted ions to identify the chemical and structural state of the phases created during implantation as a function of various implantation parameters (dose, temperature). Temperature is the particularly parameter. Its influence is put in evidence both during implantation and during annealings under vacuum. Nitrogen distribution profiles are performed thanks to the non destructive /sup 15/N(p,$\alpha\gamma$)/sup 12/C nuclear reaction. The chemical state of the Fe-N phases formed by implantation is determined using first Electron Conversion Moessbauer Spectroscopy and secondly, as a complement, using grazing angle X ray diffraction. The detected compounds are ϵ-nitrides, ϵ-carbonitrides, (N) - martensite and α-Fe/sub 16/N/sub 2/ whose evolution is carefully followed versus temperature. The diffraction technique reveals a texture of the implanted layer. This preferentiel orientation is found to be temperature dependent but dose independent. The carbon presence at the surface is studied as a function of implantation conditions (vacuum, temperature, dose). Carbon profiling is obtained using α backscattering (/sup 12/C(α,α') reaction at 5,7 MeV). Thus is achieved a complete characterization of the implanted zone whose evolution as a function of implantation parameters (especially temperature) is correlated with tribological results.

3711 **(MLM—3447(OP)) Metallography of maraging 350 steel.** Hutson, S.M.; Merten, C.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 9p. (CONF-8707113—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013746/JAW.

From International Metallurgical Society symposium; Monterey, CA, USA (27 Jul 1987).

A technique for etching maraging 350 steel with Glyceregia is described. Surface activation procedures are integral to this technique. Microstructural features revealed by this technique are compared with those obtained with Kalling's reagent, Fry's reagent, and 5% Nital, three etchants commonly used to reveal microstructures of maraging steels. Features which may be simultaneously revealed using Glyceregia include prior austenite grain boundaries, martensitic structure, precipitates, titanium carbo-nitrides, and reverted austenite. The other etchants examined in this investigation typically reveal only a few of the microstructural features detailed above at any one time. 11 refs., 10 figs., 2 tabs.

3712 **(ORF/M—850212) Rapid solidification technology workshops. Final report.** Gibbon, W.M. (Ontario Research Foundation, Mississauga (Canada). Materials Div.). 12 Feb 1985. 8p. (MICROLOG—86-2540). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Rapid solidification is a new technology which is being investigated for its industrial potential. For this reason, Canada Energy, Mines and Resources, Defence Research Establishment Atlantic and Ontario Research Foundation cooperated in arranging a national workshop to stimulate interest in Rapid Solidification Technology (RST) and to catalyze some industrial action. The specific objectives of this workshop were to review the effects of rapid solidification on the structure and properties of materials, examine various techniques of rapid solidification and their application, and increase industrial awareness of facilities, projects and applications involving RST in Canada.

3713 **(ORNL/Sub—85-27488/02) Cu-2 mechanical properties and microstructural stability of advanced steam cycle materials: Interim report for period October 1985-September 1987.** Carolan, R.A.; Coulombe, B.; Li, Che-Yu. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 29 Sep 1987. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF 01; 1; GPO Dep. Order Number DE88001519/JAW.

The aims of this project are, to obtain mechanical property data for the selection of alloys proposed for use in the high temperature steam cycle fossil energy plants, and to characterize the kinetics of microstructural instability in these alloys, such that long-term microstructural influences on mechanical properties can be described particularly with reference to service conditions. Alloy evaluation is based on the design criteria for advanced steam cycle plants which require a stress to rupture of 96 MPa for a 10^5 hrs life at 700°C and preferably a rupture strength of 116 MPa under the same conditions. Work to date has emphasized the alloy screening part of the program. The high temperature flow strength of a series of five modified A1S1 316 stainless steels developed at Oak Ridge National Laboratory were evaluated. Candidate alloys CE0-CE2 were Ti/V/Nb stabilized type 316 stainless steels. Alloys CE3 and AX7 were Ti/V/Nb stabilized type 316 stainless steels containing copper additions. Alloy AX7 had a lower Ti content. As a reference material a 17/14 CuMo type 316 steel, based on the composition of the alloy used in the Eddystone plant was tested. This alloy contained Ti/Nb stabilizing additions and a higher copper addition than the candidate alloys. Alloy 800H was tested for comparative purposes. All alloy compositions are given in Table 1. Alloy CE0 contains a higher Si content and Alloy CE2 contains a higher Cr content, such that the effects of these elements on intermetallic formation can be examined. Alloy CE3 has a Cu addition to produce the strengthening effect found in the 17/14 CuMo steel. Alloy CE1 has a higher Si content to aid processing (meltability, fabricability, weldability). 14 refs., 28 figs., 1 tab.

3714 **(ORNL/TM—10401) Stress and buckling analyses of the Army M198 Howitzer trails.** Gwaltney, R.C. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001406/JAW.

This report presents stress and buckling analyses of the Army's 155 mm M198 Howitzer trails. The analyses of the current aluminum baseline component was done to evaluate the design margins of the present design so that this information could be used in the design of the new "lightened" or composite howitzer. The buckling analysis showed the effects of torsional buckling and the torsional stiffening effect of the transverse bulkheads in the trails. 4 refs., 8 figs., 1 tab.

3715 **(ORNL/TM—10487) Effect of rapid solidification on stainless steel weld metal microstructures and its implications on the Schaeffler diagram.** David, S.A.; Vitek, J.M.; Reed, R.W.; Hebble, T.L. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001489/JAW.

An investigation was carried out to determine the effect of rapid solidification on the weld metal microstructure of austenitic stainless steels and its implication on the ferrite constitution diagram. A wide variety of stainless steels were laser welded at different welding speeds and laser power levels. Results indicate that both weld pool cooling rate and the postsolidification solid state cooling rates have a profound effect on the microstructures. For the steels investigated, the microstructures ranged from duplex aus-

tenite (γ) + ferrite (δ) to fully austenitic or fully ferritic. These microstructures were found to be sensitive to both cooling rates and composition. The observed results are rationalized based on rapid solidification theory. This investigation indicates that solidification rates and postsolidification cooling rates have a profound effect on the observed microstructures, thus making it impossible to predict the microstructures of rapidly cooled weld metal from the conventional constitution diagrams. The influence of the observations made in this investigation on the Schaeffler diagram is demonstrated, and possible corrections to the constitution diagram incorporating the cooling rate effects are proposed. 23 refs., 17 figs., 4 tabs.

3716 **(PB—87-225652/XAB) Comparison of the mechanical properties of KE penetrator tungsten alloys and their ballistic performance.** Ekbom, L.; Bogegard, S.; Holmberg, L.; Westerling, L. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). May 1987. 21p. (In Swedish). (FOA-C—20658-2.1). NTIS, PC E03/MF A01.

The report was presented at the 9th Symposium on Ballistics in Shrivenham, England, May 1986 as a poster. The main part was published as proceedings at the conference. Tungsten alloys used as KE penetrator materials usually contain 90-95% W and, in addition, Ni and Fe. The composition, microstructure, and the mechanical properties of one as sintered and one cold worked and annealed alloy is presented in the paper. The behavior of these alloys as penetrator materials is investigated, and the penetration channels obtained in two types of armor steel is compared to results obtained from calculations.

3717 **(PNL-SA—14997) Simulation of radiation damage in zircon.** Weber, W.J.; Maupin, G.D. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 17p. (CONF-870783—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000557/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

Radiation damage in natural zircon minerals due to alpha decay has been simulated in laboratory studies using Pu-doped synthetic zircon. These studies confirm that laboratory testing of actinide-doped materials can accurately predict the radiation-damage behavior of radioactive waste forms over geologic time, and also provide new insights into interpretation of radiation damage in natural minerals. 15 refs., 4 figs., 2 tabs.

3718 **(SAND—87-1328) Surface gouging by hypervelocity sliding contact between metallic materials.** Barker, L.M.; Trucano, T.G.; Munford, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001937/JAW.

Surface gouging due to hypervelocity sliding contact has been observed for many years above certain threshold velocities in hypervelocity gun barrels and on the rails of rocket-propelled sleds. To aid in understanding the environment of the gouging event, some order-of-magnitude calculations of pertinent temperatures, pressures, energies, times, distances are presented. The calculations of the gouging environment, together with a review of current and published observations of gouging, including metallurgical studies of gouges, leads to a hypothesis for the mechanism of gouging damage. The hypothesis is tested by computer simulation of the dynamic gouge initiation and growth phases. In addition to agreeing with experimental observations, parameter variations in the computer simulations pointed out design concepts which should result in gouge-mitigating shoes for rocket sleds. The successful results of the first test of such sled shoes are presented. 14 refs., 18 figs.

3719 **(SAND—87-1718C) Effectiveness of electrodeposited coatings in reducing atmospheric corrosion of copper substrates.** Voytko, J.E.; Guilinger, T.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-8710154—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013651/JAW.

From Symposium on electronics finishing for today and tomorrow; Wakefield, MA, USA (20 Oct 1987).

Coatings of gold, nickel, palladium, and nickel with 20 at. % phosphorus were electrodeposited on copper substrates at thicknesses of 50 and 150 microinches. These coated samples were exposed in an atmosphere of 100 ppB nitrogen dioxide, 100 ppB hydrogen sulfide, and 10 ppB chlorine, with a relative humidity of 60% and a temperature of 38°C for 332 hours. Weight gain of the samples was monitored to determine corrosion rate. Pore densities and sizes were measured after exposure to compare the performance of each deposit. Although the number of pores in the nickel coatings were fewer than in the other samples, pore sizes were significantly greater. Gold plated on nickel over a copper substrate exhibited smaller pores but a higher density. Palladium at 50 and 150 microinches performed well, thus recommending this coating for use in high reliability contacts. 7 refs., 4 tabs.

3720 **(SAND—87-1798C) Behavior and structure of metal vapor arc plasma between molten electrodes.** Zanner, F.J.; Williamson, R.L.; Hareland, W.A.; Bertram, L.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-871125—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001854/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

A metal vapor arc is utilized in the industrially important vacuum arc remelting (VAR) process to produce materials by melting and resolidification which have improved structure and chemical homogeneity. Homogeneity is dependent on achieving quasi-steady conditions in the plasma because of its thermal and MHD coupling with the molten pool atop the ingot. Optimal operating conditions of low pressure (≅0.01 torr) and short electrode gap (<15 mm) produce a diffuse arc and cathode spot behavior similar to that observed for the vacuum breaker arc. Under these conditions the arc provides a quasi-steady heat source that is considered to be the "bench mark arc" of the VAR process. Previous work has shown that deviation from the bench mark arc behavior can occur under production conditions, and is caused by electrode irregularities and liberation of gases such as CO from the molten pool. This study is an effort to characterize these behavioral deviations and discover operational conditions which stabilize the bench mark arc. 5 refs., 1 fig.

3721 **(SAND—87-2005C) The consequences of intergrain Josephson coupling in ceramic high-temperature superconductors.** Kwak, J.F.; Venturini, E.L.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870881—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013713/JAW.

From 18. conference on superconductivity in highly correlated fermion systems; Sendai, Japan (31 Aug 1987).

The transport and magnetic properties of the ceramic high T/sub c/ superconductors are best understood in terms of an intergranular network of Josephson junctions. The drastic drop of the critical current of such a network in small magnetic fields results in magnetically decoupled grains. Thus, magnetic hysteresis data on ceramic $YBa_2Cu_3O/sub\ 7-\delta/$ actually imply an intragrain critical current density over 10^6 A/cm² at 5K. Critical current versus field data provide an estimate of the product of the penetration depth and average junction size, as well as a sensitive measure of H/sub cl/. 8 refs., 3 figs.

3722 **(SAND—87-8227) The dependence of permeability and filtration on pore morphology in consolidated particulate media: Final report.** Smith, D.W.; Smugeresky, J.E.; Meyer, B.A. (Sandia National Labs., Livermore, CA (USA); Michigan Technological Univ., Houghton (USA)). Oct 1987. Contract AC04-76DR00789. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002237/JAW.

This work investigates the fundamental relations between the pore network structure of filters and their behavior in gaseous streams with respect to permeability and filtration characteristics. Several quantitative relations involving measurable pore parameters are developed to closely predict permeability in both the viscous and inertial flow regimes. Estimation of the permeabilities of layered or graded filters is also discussed. It is concluded that filters can be procured to specific permeabilities and filtration characteristics by specification of the density and either the mean pore size or

the powder particle size used in manufacture. It is recommended that filters having pore volume fractions less than 0.2 (relative densities greater than 80%) be avoided due to the rapid decline in the relative amount of interconnected porosity at higher density levels. Filtration performance in gas streams is investigated, and it is concluded that behavior is dependent on the actual service conditions. 34 refs., 24 figs., 3 tabs.

3723 **(UCRL—96560) Magnetic behavior of amorphous Fe-Ni-Zr alloys and their response to radiation damage.** Violet, C.E.; Borg, R.J.; May, L.; Rao, K.V.; Nogues, J.; Taylor, R.D.; Batra, A.P. (Lawrence Livermore National Lab., CA (USA); Royal Inst. of Tech., Stockholm (Sweden); Los Alamos National Lab., NM (USA); Howard Univ., Washington, DC (USA)). Aug 1987. Contract W-7405-ENG-48. 6p. (CONF-870825—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000424/JAW.

From International conference on the applications of the Mossbauer effect; Melbourne, Australia (17 Aug 1987).

The magnetic properties of two amorphous Fe-Ni-Zr alloys, Fe/sub 89.7/Ni/sub 0.03/Zr_{10} and $Fe_{70}Ni_{20}Zr_{10}$, both in the "as cast" and neutron irradiated states were investigated by Moessbauer spectroscopy and dc magnetic susceptibility measurements. The upper magnetic ordering temperatures of Fe/sub 89.7/Ni/sub 0.03/Zr_{10} are 232°K and 246°K for the "as cast" and irradiated samples, respectively. The magnetic ordering temperature for $Fe_{70}Ni_{20}Zr_{10}$ was about 478°K for both the "as cast" and irradiated samples. Both compositions yield magnetic hyperfine spectra, which show a considerable relaxation effect that must be explicitly considered in the calculation of the average local Fe moments. When this is done, these values derived from Moessbauer spectra are in good agreement with the dc susceptibility values. The effects of neutron irradiation on the magnetic properties of these alloys are small. 4 refs., 2 figs., 1 tab.

3724 **(VTT-PUBL—36) On the relations between cyclic contraction ratio flowstress and deformation mechanisms in bainitic CrMoV steels.** Rahka, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland); Helsinki Univ. of Technology, Otaniemi (Finland)). Apr 1987. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753043/JAW.

The cyclic diametral strain and stress response of macroscopically untextured (nominally isotropic) bainitc Cr-Mo-V steels has been studied. The total axial strain amplitudes were controlled and chosen so that a range of ratios of plastic and elastic elongations were used extending from 0.04 to 5. The trend of the cyclic diametral strain was sometimes found to drastically deviate from the commonly used Poisson's ratio when the ratio of plastic and elastic elongation was around 3 for the uncycled material. The unusual initial increase in cyclic contraction ratio for these conditions was attributed to strain concentration and the decrease to strain decentration. A condition for these unpredictable macroscopic effects seems to be that the effective strengthening structure should be sufficiently unstable during the cyclic strain applied. At room temperature fatigue slip bands of high local density and number are created in these conditions. At elevated temperature applied strains larger than — 0.3% give rise to an increasing mechanically activated dynamic recovery which operates despite a dense carbide dispersion. The amount of recovery and simultaneous dislocation annihilation increase and act to lower the flow strength with rising strain. Their extent depend on the strain rate. An apparent maximum in dynamic recovery was observed as a minimum in cyclic yield strength at the same strain for which the pronounced unpredictable diametral strain was observed. Similar diametral strain effects in monotonic tension tests on different materials reported in the published literature indicate that the effects are most probably related to the particular dominant mode of slip at strain levels for which the ratio of plastic and elastic strain (e/sub p//e/sub E/) is around three. Slip is then dominantly planar. (Abstract Truncated)

3725 **Effect of transverse compressive stress on the critical current and upper critical field of Nb_3Sn.** Ekin, J.W. (Electromagnetic Technology Division, National Bureau of Standards, Boulder, Colorado 80303). *Journal of Applied Physics;* **62**: No. 12, 4829-4834(15 Dec 1987).

A large reversible degradation of the critical current of multifilamentary Nb_3Sn superconductors has been observed when uniaxial compressive stress is applied transverse to the conductor axis at 4 K. In bronze-process multifilamentary Nb_3Sn, the onset of significant degradation occurs at about 50 MPa. In an applied field of 10 T, the magnitude of the effect is about seven times larger for transverse stress than for stress applied along the conductor axis. The transverse stress effect increases with magnetic field and is associated with a reversible degradation of the upper critical field. The intrinsic effect of transverse stress on the upper critical field is about ten times greater than for axial stress. Although axial stresses on the Nb_3Sn filaments are greater than transverse stresses in most applications, the transverse stress effect will need to be considered in the internal design of large magnets because of the greater sensitivity of Nb_3Sn to transverse stress. It is shown that the transverse stress from the Lorentz force on the conductor is proportional to conductor thickness. This will place limits on conductor dimensions and the spacing between distributed reinforcement in large magnets. The effect may be particularly significant in cabled conductors where large transverse stress concentrations can occur at strand crossover points.

3726 **Damascus steel, Part I: Indian wootz steel.** Verhoeven, J.D. (Dept. of Materials Science and Engineering, Ames Lab.-USDOE, Ames, IA 50011). *Metallography;* **20**: No. 2, 145-152(May 1987).

Available literature on the ancient Indian wootz process for producing the steel believed to have been used in Damascus blades is reviewed. There is uncertainty in the literature as to whether the wootz metal had an as-cast carbon composition of around 1.6% or a composition in the 2.5 to 3.5% range which was then reduced to 1.6% by decarburization. Some arguments are presented which favor the lower as-cast carbon level, and therefore imply that crucible temperatures in the 1400°-1450°C range must have been achieved in the wootz process.

3727 **Damascus steel, Part II: Origin of the damask pattern.** Verhoeven, J.D.; Jones, L.L. (Dept. of Materials Science and Engineering and Ames Lab.-USDOE, Ames, IA 50011). *Metallography;* **20**: No. 2, 153-180(May 1987). Contract W-7405-ENG-82.

A study was carried out to evaluate the role of the impurity elements found Damascus steels on the origin of the cementite (Cm) particles that produce the characteristics pattern of Damascus blade. It is shown that the high phosphorous (P) impurity levels of Damascus steels could have controlled the mechanism of Cm formation. Experiments on small steel castings with impurity compositions matching that of Damascus steels reveal that the P between impurity content produces two significant effects: it results in formation of primary Cm between austenite dendrites upon solidification that could lead to the damask pattern of the final sword; and it causes a graphitization of Cm on certain heat-treat cycles, which destroys the damask pattern. The origin of the Cm particles in casting and forgoing a Damasus steel blade is discussed in view of these results.

3728 **On the solution to a Cauchy principal value integral equation which arises in fracture mechanics.** Gautesen, A.K.; Dundurs, J. (Dept. of Mathematics and Ames Lab., Iowa State Univ., Ames, IA 50011). *SIAM Journal on Applied Mathemadics;* **47**: No. 1, 109-116(Feb 1987). Contract W-7405-ENG-82.

The authors give the exact solution to a Cauchy principal value integral equation on a split interval. This equation arose in the study of the fracture mechanics problem of an interface crack in tension and shear fields. The method of solution is of independent interest.

3729 **Method for converting uranium oxides to uranium metal.** Duerksen, W.K. (to Dept. of Energy). US Patent Application 6-006,841. 1 Jan 1987. 9p. Contract AC05-84OR21400. DE88000860 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000860/JAW.

A process is described for converting scrap and waste uranium oxide to uranium metal. The uranium oxide is sequentially re-

duced with a suitable reducing agent to a mixture of uranium metal and oxide products. The uranium metal is then converted to uranium hydride and the uranium hydride-containing mixtures is then cooled to a temperature less than -100°C in an inert liquid which renders the uranium hydride ferromagnetic. The uranium hydride is then magnetically separated from the cooled mixture. The separated uranium hydride is readily converted to uranium metal by heating in an inert atmosphere. This process is environmentally acceptable and eliminates the use of hydrogen fluoride as well as the explosive conditions encountered in the previously employed bomb-reduction processes utilized for converting uranium oxides to uranium metal.

3730 **The role of interfaces during oxidation.** Harris, J.E. *Journal of Metals;* 39: No. 1, 34-36(Jan 1987).

During oxidation of a metal sample in air, the new oxide could, in principle, form at the oxide/oxide interface, the oxide/oxide grain boundaries, the oxide/metal interface or the metal/metal grain boundaries. This paper discusses the diffusional properties of the various interfaces and boundaries and proposes mechanisms for the inhibition of the oxidation reaction by second phase particles.

3731 **(ORNL-tr—87/24) Study of the temperature dependence of the mechanical characteristics of the steels GX 5 CrNi 13 4 and GGG 40 in tensile and bending tests.** Kopfer, G. (Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Eisenhuettenkunde). 1987. Contract AC05-84OR21400. Report to Gesellschaft fuer Nuklear-Service mbH, June 12, 1979. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001469/JAW.

This report addresses the results of the study of the temperature dependence of the mechanical characteristics of two cast materials. Diagrams show the yield point and the tensile strength of the steel GX 5 CrNi 13 4 - as determined from the bending test. For the material GGG 40 we tested the yield point and the tensile strength in unnotched tensile specimens and also the yield point and strength in bending tests with differently notched notched-bar impact bend test specimens as a function of temperature. The steel GX 4 CrNi 13 4 exhibits very good toughness to temperatures of -196°C without any indication of a drop, whereas the GGG 40 casting exhibits a sharp drop in toughness between -130 and -175°C. This embrittlement is virtually independent of the notch sharpness, which is also expressed by the shape of the fracture toughness-temperature curve. Only below about -140°C can valid K/sub IC/ values be determined, since above this temperature the sharp increase in toughness makes an exact K/sub IC/ determination impossible. 33 figs., 15 tabs.

3732 **Dynamic high pressure process for fabricating superconducting and permanent magnetic materials.** Nellis, W.J.; Maple, M.B.; Geballe, T.H. (to Dept. of Energy). US Patent Application 6-937,794. 4 Dec 1986. 35p. Contract W-7405-ENG-48. DE88000848 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000848/JAW.

Shock waves directed on thin layers of materials is used to form superconducting and permanent magnetic materials with improved microstructures. 9 figs.

3733 **Method for preparing hydride configurations and reactive metal surfaces.** Silver, G.L. (to Dept. of Energy). US Patent Application 6-935,981. 28 Nov 1986. 24p. Contract AC04-76DP00053. DE88000845 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000845/JAW.

Disclosed is a method for preparing highly hydrogen-reactive surfaces on metals which normally require substantial heating, high pressures, or an extended induction period. The method involves pretreatment of surfaces with either a nonoxidizing acid or hydrogen gas to form a hydrogen-bearing coating. The coated metal is heated in the absence of moisture and oxygen for a period sufficient to decompose the coating, and then cooled to room temperature. Surfaces so treated will react almost instantaneously with hydrogen gas at room temperature and low pressure. The method is particularly applicable to uranium, thorium, and lanthanide metals. 3 figs.

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REFER ALSO TO CITATION(S) 2950, 2951, 3447, 3613, 3681, 3707, 3720, 3728, 3769, 3775, 3783, 3795, 4022, 5174

3734 **(AAEC/E—648) Microstructural aspects of SYNROC from Sandia precursor. 1. Some effects of process variables.** Stevens, G.T.; Watson, K.G.; Bellrose, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700288/JAW.

Typical microstructures formed in Synroc C have been observed by optical and scanning electron microscopy. The principal effects of segregation, variation of calciner atmosphere and change in hot-pressing conditions, are summarised.

3735 **(AAEC/E—649) Microstructural aspects of SYNROC from Sandia precursor. 2. Some effects of impurities.** Stevens, G.T.; Watson, K.G.; Bellrose, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700289/JAW.

A description is given of the effects of small amounts of certain elements (Si, Na, P, Fe, Cl, F and S), which could be considered to be processing contaminants, on the microstructure of a particular batch of Synroc C.

3736 **(AD-A—183442/3/XAB) Silicon nitride ceramic fibers from preceramic polymers. Technical report.** Laine, R.M.; Blum, Y.D.; Chow, A.; Schwartz, K.S. (SRI International, Menlo Park, CA (USA)). Jun 1987. 21p. (TR—8). NTIS, PC A02/MF A01.

The program objectives are to develop: (1) Transition metal catalyzed synthetic routes to designed, tractable silicon nitride (Si_3N_4) preceramic polymers (polysilazanes) based on SRI developed technology; (2) Methods of spinning the resultant polysilazanes into continuous preceramic fibers; and, (3) Pyrolysis techniques for transforming the preceramic fibers into high strength Si_3N_4 and silicon carbide nitride (SiCN) fibers. In the past year, polysilazanes driven from precursors of the type-H_3SiNMe were prepared, whose viscoelastic properties can be carefully controlled by type of catalyst and/or reaction conditions. This control permitted drawing preceramic fibers of diameters as small as 10 um. Furthermore, pyrolysis methodology was developed from which ceramic yields of 50-70% were obtained with Si_3N_4 purities ranging from 80-99%. It was discovered that polymer molecular weight greatly influences the ceramic yield, but only monomer design or pyrolysis under a reactive atmosphere seems to influence selectivity to specific ceramic products.

3737 (BNL—52090, pp 164-179) **Photoemission and photofield emission some results.** Boussoukaya, M.; Bergeret, H.; Chehab, R. Leblond, B. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Experimental studies on different photocathodes, show that the lowering of the work function of La B_6 from about 4.5 eV to 2.5 eV under laser light cleaning leads to quantum yield enhancement of 10^{-} # instead of 10^{-7} previously observed. Pulsed photofield emission using either ns or ps lasers shows a very high photoemissivity in UV, green and infrared light for microemitters of both for a single needle or an array. Photocurrents of more than 10A were obtained from a single tungsten needle in green light. High quantum yields of more than one were obtained and can be explained by the contributions of many effects, e.g. potential barrier lowering the Schottky effect or by the tunneling effect which greatly improves the escape probability for excited electrons by narrowing the potential barrier. It can be explained also by the size effect of the microemitters which induces an enhancement of the local static electric field and by different absorption phenomena.

3738 **(CEA-CONF—8922) Plasma projection under controlled atmosphere.** Schnedecker, G.; Boncoeur, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Dec 1986. 4p. (In French). (CONF-8612104—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753245/JAW.

From Colloquium of the French group of ceramics; Paris, France (11 Dec 1986).

Ceramics and metals like B/sub 4/C, Si B/sub 6/, Ti B/sub 2/, Al/sub 2/O/sub 3/, Y/sub 2/O/sub 3/, W, Al, MCrAlY are deposited on metals, graphites and resin based composite materials in an argon atmosphere with a performing cooling system. High purity deposits on any substrate is made possible with this process.

3739 **(CEA-R—5381) Electron radiation defects in tantalum carbides.** Gosset, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Feb 1987. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750250/JAW.

We have studied radiation damage in TaC /sub 1-x/ at 21 K, by means of electrical resistivity measurements. Threshold displacement energies and specific resistivities of C and of Ta defects have been determined, as well as the C recombinations volume. From isochronal and isothermal recovery experiments versus composition x, electron energy and dose we have separated the recovery stages of C and of Ta defects (three stages at 80 K, 170 K and 275 K for C and one stage between 40 and 180 K for Ta). They are due to interstitial migration mechanisms. The first stage at 80 K results from close pair recombination with a given activation energy. The three stages structures of C defects desappears for x=0,20, with just one single stage (between 40 K and 250 K, 200% high). This can be related to modifications of the vacancy order parameters due to instertitial migration.

3740 **(CEA-R—5382) Electron microscopy study of radiation effects in boron carbide.** Stoto, T. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Mar 1987. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750095/JAW.

Boron carbide is a disordered non-stoechiometric material with a strongly microtwinned polycrystallyne microstructure. This ceramic is among the candidate materials for the first wall coating in fusion reactor and is used as a neutron absorber in the control rods of fast breeder reactors. The present work deals with the nature of radiation damage in this solid. Because of helium internal production, neutron irradiated boron carbide is affected by swelling and by a strong microcracking which can break up a pellet in fine powder. These processes are rather intensitive to the irradiation parameters (temperature, flux and even neutron spectrum). Transmission electron microscopy of samples irradiated by the fast neutrons of a reactor, the electrons of a high voltage electron microscope and of samples implanted with helium ions was used to understand the respective roles of helium and point defects in the processes of swelling and microcracking. The design of an irradiation chamber for helium implantation at controlled temperature from 600 to 1700/sup 0/C was an important technical part of this work.

3741 **(CONF-8708134—1) Colloidal stability of oxidized silicon particles in ethanolic and aqueous media.** DeLiso, E.M.; Bleier, A. (Rutgers--the State Univ., Piscataway, NJ (USA). Center for Ceramics Research; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014783/JAW.

From 18. annual meeting of the Fine Particle Society; Boston, MA, USA (3 Aug 1987).

This work constitutes an initial effort to understand the broad range of surface and colloidal properties exhibited by oxidized silicon powder. We conclude the following: (1) Colloidal stability of oxidized Si powder is of electrostatic origin in 0.15 M NaCl (Aq). The greatest stability exist at pH 9 owing to a sufficiently high zeta potential of -31.8 mV. A critical concentration of electrolyte exists between 10^{-3} M and 0.15 M NaCl (Aq) and for the high electrolyte concentration a critical value of zeta exists between -16.5 and -31.8 mV; (2) Stability in 10^{-3} M LiCl (ETOH) is high in the absence of KD-2 and is reduced by small additions of this material. These conditions correspond to submonolayer coverage. Adsorption of KD-2 onto oxidized Si appears to arise from the interaction of the basic amine functionality of the dispersant with the acidic oxidized silicon surface; (3) High concentrations of KD-2 reduce the destabilizing effect but do not achieve maximum stability; and (4) Comparison of estimated molecular cross-sectional areas for KD-2 suggest that monolayer coverage corresponds to only about 17% of the available surface. Furthermore, indiscriminate adsorption resulting from reduced solute-solvent interactions is not considered probable. 16 refs., 7 figs., 2 tabs.

3742 **(CONF-8708151—1) Structural characterization of ion implanted beta-SiC thin films.** Edmond, J.A.; Davis, R.F.; Withrow, S.P. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Science and Engineering; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014567/JAW.

From Silicon carbide symposium; Columbus, OH, USA (2 Aug 1987).

Thin films of β-SiC (100) grown on Si have been implanted with Al, P, Si and Si plus C. The temperature dependence of implantation-induced damage was studied between 77K and 1023K using transmission electron microscopy and Rutherford backscattering/channeling. Amorphous layers resulting from implantation of any of the above species recrystallized via solid-phase-epitaxy during post-implantation annealing between 1973K and 2073K. As such, this latter process necessitated the prior removal of the Si substrate. However, the resultant layers were very defective. Increasing the sample temperature to 1023K during implantation allowed in situ dynamic annealing of the samples and therefore, greatly reduced the residual damage to the lattice. No additional annealing was required for structural recovery.

3743 **(CONF-8710177—1-Vugraphs) Electron microscopy studies of tensile cyclic fatigue-tested silicon nitride ceramics.** Allard, L.F.; Nolan, T.A.; Liu, K.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001438/JAW.

From Department of Materials Science and Engineering seminar; Ann Arbor, MI, USA (19 Oct 1987).

Specimens of a commercial silicon nitride material, tested in tensile fast fracture and tensile-tensile cyclic fatigue at elevated temperatures, were examined to determine the failure mechanisms and the effects of the mechanical tests on the microstructure of the material. It is of interest to determine the extent to which the failures are controlled by macrodefects, rather than by microstructural phenomena. For these results, fracture surfaces were being characterized in detail utilizing both optical and low voltage scanning electron microscopy (SEM) techniques. General microstructures were characterized by both compositional backscattered SEM methods, and in greater detail by techniques of transmission electron microscopy (TEM). Tests at 1200°C indicated a strain-hardening behavior similar to that observed in metal alloys. Preliminary TEM results comparing the microstructural features of as-sintered material with those of specimens from this series are presented in the form of vugraphs.

3744 **(INIS-BR—873) Melting of Nb/sub 2/O/sub 5/ glass in a RF furnace.** Aranha, N.; Barbosa, L.C. (Associacao Brasileira de Ceramica, Sao Paulo). 1987. 6p. (In Portuguese). (CONF-8705175—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700207/JAW.

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Nd/sub 2/O/sub 5/ were sucessfully melted in a furnace under He inert atmosphere. After melting, the glasses presented refractive index about 1,73 +- 0,01, free of bubbles with good homogeneity. The only problem was the yellow colour produced by impurities originating in the niobium. To Brazil, this glass has strategic importance, because the world largest niobum resources are

founded in Brazil and other glass components, as P/sub 2/O/sub 5/ and PbO are also easily founded.

3745 (INIS-BR—874, pp 104) **Study of the ZrO/sub 2/-FeO-Fe/sub 2/O/sub 3/ system by thermogravimetry in partial pressure of oxygen and temperatures up to 1500/sup 0/C.** Goldschmidt, R.H.; Kiminami, A. (Paraiba Univ., Campina Grande, Brazil. Dept. de Engenharia Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The dissociation of iron oxide in the ZrO/sub 2/-FeO-Fe/sub 2/O/sub 3/ system was investigated in function of the temperature and the constant partial pressure of oxygen by thermal gravimetric analysis. The equilibrium diagram was constructed where the equilibrium relation between the solid phase of zirconium oxide, hematite and magnetite in 1437/sup 0/C and PO/sub 2/ = 0.21 atm/m, as well as the equilibrium relation between the solid phase of zirconium oxide and hematite in lower temperatures than 1437/sup 0/C were determined.

3746 (INIS-BR—874, pp 65) **Preparation of ZiO/sub 2/ specimens for transmission electron microscopy.** Bressiani, A.H.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil. Dept. de Metalurgia Nuclear). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The determination of average grain size, of the presence of monoclinic, tetragonal and cubic phases, as well as their relative distributions are necessary for the study of several partially stabilized zirconia properties. However, the phase distributions can be changed during the preparation of specimens for transmission electron microscopy, yielding misleading results. In this work suitable preparation method is reported.

3747 (INIS-BR—874, pp 48) **Electrical conductivity and defect structure in tantalum doped TiO/sub 2/.** Paulin Filho, P.I.; Miller, G.R. (Sao Carlos Univ., Brazil. Dept. de Engenharia de Materiais; Standard Oil Co., Niagara Falls, NY, USA). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The electrical conductivity of rutile doped with 1 and 3% tantalum reduced at low oxygen partial pressures was measured at room temperature. Complex impedance measurements have shown that the microstructure, through the conductivity of grains and grain boundaries play an important role total conductivity. The conduction mecanisms are discussed in terms of defect structure created by incorporation of pentavalent ions (Ta/sup +5/) in the crystal structure of rutile. A model is suggested based on the complex impedance measurements. In this model, a circuit of resistors and capacitor are associated to the grains and grain boundaries.

3748 (INIS-BR—874) **Proceedings of the 31. Brazilian Congress on Ceramic - Vol. 1.** (Associacao Brasileira de Ceramica, Sao Paulo). 1987. 554p. (In Portuguese). (CONF-8705175—Vol.1). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW.

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Papers about the utilization and fabrication of ceramic compounds in nuclear industry are presented. Some aspects about mechanical and physical properties of this compounds are commented. (E.G.).

3749 (INIS-BR—874, pp 15) **Production of mullite-zirconia ceramics composites by 'In situ' reaction.** Melo, F.C.L. de; Cairo, C.A.A.; Piorino Neto, F.; Devezas, T.C. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Pesquisas e Desenvolvimento). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Mullita-zirconia ceramic composites were produced by 'In situ' reaction of alumina and brazilian zircon. The ideal curve of thermal treatment (reaction + sinterization) was determined for the obtention of composites of maximum mechanical resistence. The retained fraction of tetragonal fase was evaluated by X-ray difraction and correlated with the values of mechanical resistence obtained by different treatment curves. The performance of the developed composites under corrosion and thermal shock was evaluated by glass casting.

3750 (INIS-BR—874, pp 28) **Sintering kinetics of U/sub 3/O/sub 8/ microspheres.** Godoy, A.L.E. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Shrinkage and grain growth kinetics data are presented for microspheres produced from gels. The diametral variations may be described with an accuracy of the order of 8% by means of modified Gompertz equations. Using finite differences analysis it was shown that those equations correspond to deviations (average 3%) relative to the experimental values smaller than those obtained using simple exponential models. Relevant microstructural aspects are attested by optical and electron ceramography. Densities of the order of 98% of the theoretical value are reached in times and temperatures substantially smaller than those corresponding to ceramics formed from powder.

3751 (INIS-BR—874, pp 176) **Characterization and sintering of niobium-ATR alumina.** Sibuya, N.H.; Iwasaki, H.; Suzuki, C.K.; Pinatti, D.G. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

In the niobium aluminothermy a slag is produced, composed mostly of alumina and other compounds such as niobium oxide and silica. The phase composition of this ATR alumina was characterized by X-ray powder diffractometry, and afterwards this alumina was subjected to leaching processes. It was noticed that the original content of 70% α-alumina in slag rose to 95% after the calcination. ATR alumina (leached and calcined, and without any treatment) was used to make pressed bodies which were fired in air at 1200 to 1400/sup 0/C for 1 to 10,5 hours; and in vacuum at 1550 to 1800$0C for 2 hours. Characterization was done by density measurements, X-ray diffractometry and ultrasonic analysis. Ultrasonic analysis of some vacuum fired bodies showed londitudinal velocities close to the value found in literature. Correlation of several techniques measurements disclosed the niobium oxide interference in sintering.

3752 (INIS-BR—874, pp 311) **Studies of alumina additions in zirconia-magnesia.** Muccillo, R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Ionic conductivity measurements have been carried out in the 500/sup 0/C - 1000/sup 0/C temperature range in Mg - PSZ (Partially Stabilized Zirconia) with 0.5 to 10 mol% alumina additions. All specimens were prepared by pressing followed by pre-and sintering at 1000/sup 0/C/2h and 1450/sup 0/C/4h, respectively.

Thermal hysteresis of the ionic conductivity have been detected, probably due to phase changes in the Mg-PSZ samples. The results show that alumina additions up to 2.1% enhances densification with no major variations in electrical resistivity values.

3753 (INIS-BR—874, pp 362) **Production of high purity aluminas: II - Characterization.** Franceschini Filho, D.F.; Morschbacker, A.L.R.C.; Fonseca, M.C.; Mello, R.T. de; Ferreira Filho, J.M. (Petroflex Ind. e Com. S.A., Rio de Janeiro, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

This paper presents a characterization study on various samples of aluminum hydroxide (pseudoboemite). Results of X-ray diffraction (identification, mean crystal size, degree of crystallinity); BET surface area and loss of ignition of the samples are displayed. The degree of crystallinity is found to be of great usefullness in the characterization of this kind of material. We point out the variety of products that can be obtained with the method of preparation used.

3754 (INIS-BR—874, pp 131) **Sintering and microstructure of ZnO varistor.** Leite, E.R.; Longo, E.; Varela, J.A. (Sao Carlos Univ., Brazil. Dept. de Engenharia de Materiais; Sao Carlos Univ., Brazil. Dept. de Quimica; UNESP, Araraquara, Brazil. Inst. de Quimica). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The sintering and microstructure of ZnO-Bi/sub 2/O/sub 3/ (ZB) and ZnO-Sb/sub 2/O/sub 3/-CoO-Bi/sub 2/O/sub 3/ (ZSCB) varistors in several temperatures, for one hour in dry air temperature were studied. The compounds were analyzed by scanning electron microscopy, X-ray diffraction, differential thermal analysis and the density and porosity were determined by mercury picnometry. The experimental results showed that the ZB and ZSCB system sinters by liquid means and that liquid will control the density and grain growth mechanisms. (E.G.).

3755 (INIS-BR—874, pp 345) **Study of mechanical properties of the system Al/sub 2/O/sub 3/-ZrO/sub 2/.** Acchar, W.; Madruga, T.P.; Costa, C.R.C. da. (Instituto Militar de Engenharia, Rio de Janeiro, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The effects of zirconia additions on the mechanical properties of alumina have been subject of great interest due to its large application. This paper show the results of fracture thoughness and strength of alumina ceramica with zirconia.

3756 (Juel—2102) **Characteristic strength values for design of ceramic components in energy generating plants.** Buresch, F.E.; Meyer, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralinstitut fuer Angewandte Mathematik). Dec 1986. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750020/JAW.

Failure of ceramics and other brittle materials is a volumetric damage process. In highly stressed regions of microstructural heterogeneities or design notches microcracks are evaluated. In many ceramics microcrack nuclei are the potential micromechanical energy release rates induced by internal stresses. Their parameters are strongly affected by the density of the material. It was found experimentally that small density fluctuations cause mutlimodal strength distributions which are related to changes of fracture mechanisms. The continuum-mechanics approach to a strength distribution with the unimodal Weibull distribution function assumes one type of statistically distributed flaws in a homogeneous and isotropic material. Thus groups of specimens with different microstructures show a multimodal strength distribution. Following earlier works multimodal strength distributions are separated in unimodal Weibull distributions using physical and statistical methods. Each separated Weibull distribution characterizes a specific material variation with a specific microstructure. Within each material variation bend and tensile strength data can be converted into one another with respect to the stress volume integral. Lifetime predictions hold only for a specific microstructure, that means the specimens and the components have identical microstructures. Contaminated data are characterized physically as well as statistically. The experimental work was exemplified with commercial high temperature ceramics of the mullite and silica type.

3757 (KFK—4209) **Crack behaviour in ceramic materials under static, slowly increasing and cyclic loading conditions.** Brugger, N. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Jun 1987. 144p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750145/JAW.

Crack growth studies were realized with cantilever specimen (made of glass ceramics, silicon nitrides, and silicon carbide), which were predamaged by a new 'Bridge-Method'. The behaviour of these macroscopic, naturally sharp cracks was studied under static, dynamic and cyclic conditions. Instead of the 'critical' stress intensity factors K/sub IC/ or K/sub Imax/, the main purpose of this work was to show the existence and determination of stress intensity factors K/sub IO/ which leads to solid crack stagnation under various loading conditions. Particularly under cyclic loading, slow crack growth starts up to 50% of K/sub Imax/. Therefore the stress intensity factors K/sub IO,schw/ should be used for safe ceramic construction, where no crack extension even after 10/sup 7/ load cycles take place. Increasing crack resistance with increasing crack length, known from alumina, was also shown by Si/sub 3/N/sub 4/ and SiC-materials. The studies of the crack opening and crack growth show clear indications for frictional effects behind the crack tip opposed to the frequently postulated process zone model. The positive influence of rough crack walls leads to some suggestions for the improvement of ceramic materials on the way to higher crack resistance and increased fracture toughness. (orig./IHOE).

3758 (MU/MMS—8406) **The development of non-destructive testing techniques for the evaluation of sintered solid electrolytes. Phase 3. Final report.** Nicholson, P.S. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Metallurgy and Materials Science). Jun 1984. 35p. (MICROLOG—85-0278). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report is concerned with the development of techniques of identifying defects in high performance ceramics nondestructively using ultrasound. Since ceramic component performance is degraded by even the smallest of flaws, it is important to identify these components, which might fail during normal operation. Ultrasound is one identification technique; however, to detect very small defects, high frequency sound must be used. Transducers which produce sound in the frequency and power ranges that can penetrate the components are difficult to manufacture for many reasons. Some of these reasons are examined, with a report on the progress and success in overcoming them. 26 figs.

3759 (NSRF—860720) **Development of engineering ceramics having high toughness, thermal shock and erosion resistance.** Kazi, H.A. (Nova Scotia Research Foundation Corporation, Dartmouth (Canada)). 20 Jul 1986. 62p. (MICROLOG—86-06700). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Alumina and alumina particulate composite samples, made of fine powders of various purity and fine-grained stabilized zirconia, were prepared by both slipcasting and isostatic pressing methods. All these specimens were tested for abrasion, thermal shock resistance, and fracture toughness, as well as hardness, density, and mi-

crostructure. The procedures for sample preparation and methodology are described. 22 figs., 6 tabs.

3760 **(PB—87-223582/XAB) Electronic structure of La-Cu and Y-Ba-Cu oxides: ground-state properties and photoemission spectra.** Temmerman, W.M.; Stocks, G.M.; Durham, P.J.; Sterne, P.A. (Daresbury Lab. (UK)). May 1987. 16p. (DL/SCI/P—551T). NTIS, PC E03/MF E03.

The electronic structure of La_2CuO_4 and $YBa_2Cu_3O_7$ was evaluated within the Local Density Approximation using the LMTO-ASA method. The calculated lattice parameter for the La-based oxide is within 1% of the experimental value. Theoretical photoemission (and inverse photoemission) spectra XPS (and BIS) are presented. The spectra are dominated by the emission from the Cu sites and show a Cu d band strongly affected by the bonding with the O p levels.

3761 **(PNL-SA—14795) Raman microprobe characterization of dielectric films following high-energy pulsed laser irradiation.** Exarhos, G.J.; Friedrich, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 13p. (CONF-870725—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000559/JAW.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

The interaction of intense laser radiation with thin oxide films often results in degradation of their optical properties through the formation of regions characterized by stress inhomogeneity, phase transformation/recrystallization, or marked material ablation. A Raman microprobe investigation of several sputter-deposited single and multi-layer films was initiated to study in greater detail the molecular changes induced by high energy irradiation. Catastrophic damage was observed in submillimeter regions whose shape and depth depend upon laser energy, wavelength, and the cumulative number of incident pulses. Spatially resolved Raman spectra acquired with a resolution of a few micrometers were correlated with a specific damage morphology. Microprobe measurements also reveal nonuniform stress in the coatings. 8 refs., 4 figs.

3762 **(SAND—87-0594C) Bipolaron formation in B_{12} and $B_{11}C$ icosahedra.** Howard, I.A.; Beckel, C.L.; Emin, D. (Sandia National Labs., Albuquerque, NM (USA); Queen Mary Coll., London (UK). Dept. of Physics; New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy). 1987. Contract AC04-76DP00789. 9p. (CONF-870438—36). NTIS, PC A02/MF A01; GPO Dep. Order Number DE87007087/JAW.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Boron carbides contain both B_{12} and $B_{11}C$ icosahedra. Electronic transport is believed to occur by means of bipolaron hopping between only $B_{11}C$ icosahedra. We calculated the energy reduction, associated atomic displacements and charge distribution for a pair of electrons added to the isoelectronic tied-off icosahedral clusters B_{12} and $B_{11}C^+$ in a neutral environment. The computations are performed with a self-consistent molecular-orbital method, PRDDO. We found a total energy reduction of $\simeq$3.7 eV for two electrons added to a B_{12} icosahedron. For two electrons added to a $(B_{11}C)^+$ icosahedron we found a total energy reduction of $\simeq$18.2 eV. Thus, we find $(B_{11}C)^+$ icosahedra to be energetically favored over B_{12} icosahedra as bipolaron sites. The positive charge associated with a $(B_{11}C)^+$ icosahedron is distributed over all but one of the icosahedron's sites. Concomitantly, we found the added two electrons of the bipolaron to be distributed over all twelve sites of the $B_{11}C$ icosahedron. We found the energy difference between an electron pair added to B_{12} and $(B_{11}C)^+$ icosahedra to arise principally from the increased Coulombic attraction provided by the extra positive charge of the $(B_{11}C)^+$ icosahedron. 10 refs., 1 fig.

3763 **(SAND—87-1275C) High temperature stability of superconducting YBa_2Cu_3O/sub x/ as characterized by x-ray diffraction.** Eatough, M.O.; Aselage, T.L.; Keefer, K.D.; Ginley, D.S.; Morosin, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-8708150—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001856/JAW.

From 36. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1987).

The properties of single-phase YBa_2Cu_3O/sub x/ ($x = 6.9$) are characterized within the range of conventional processing temperatures. In addition, several pellets of the material were subjected to a high pressure oxygen treatment in an effort to increase oxygen content. Lattice parameter measurements were also made. At room temperature it had an orthorhombic structure with parameters near: a = 3.82A, b = 3.88A and c = 11.68A. At lower oxygen values ($x \leq 6.5$) the structure was tetragonal with parameters near: a = 3.86 and c = 11.80. A symmetry change occurred from orthorhombic to tetragonal between 450°C and 650°C dependent on oxygen partial pressure. The material was stable in air to about 1025°C. 4 refs., 5 figs., 3 tabs. (CBS)

3764 **Evidence for weak link and anisotropy limitations on the transport critical current in bulk polycrystalline $Y_1Ba_2Cu_3O$/sub x/.** Ekin, J.W.; Braginski, A.I.; Panson, A.J.; Janocko, M.A.; Capone D.W. II; Zaluzec, N.J.; Flandermeyer, B.; de Lima, O.F.; Hong, M.; Kwo, J.; and others. (Electromagnetic Technology Division, National Bureau of Standards, Boulder, Colorado 80303). *Journal of Applied Physics;* **62**: No. 12, 4821-4828(15 Dec 1987).

Measurements of the transport critical-current density (J/sub c/), magnetization J/sub c/, and magnetoresistance in a number of bulk sintered samples of $Y_1Ba_2Cu_3O$/sub x/ from several different laboratories indicate that the transport J/sub c/ is limited by weak-link regions between high J/sub c/ regions. The weak-link J/sub c/ has a Josephson character, decreasing by two orders of magnitude as the magnetic field is increased from 0.1 to 10 mT at 77 K. An examination of the grain-boundary region in $Y_1Ba_2Cu_3O$/sub x/ shows no observable impurities or second phases to the scale of the [001] lattice planes ($\sim$12 A). The effect of intrinsic conduction anisotropy is discussed. A current-transfer model is proposed in which weak conduction along the c axis plays a role in limiting J/sub c/ at grain boundaries. Orienting the grains in the powder state during processing may result in enhanced transport J/sub c/ in bulk conductors.

3765 **Formation of thin superconducting films by the laser processing method.** Narayan, J.; Biunno, N.; Singh, R.; Holland, O.W.; Auciello, O. (Materials Science and Engineering Department, North Carolina State University, Raleigh, North Carolina 27695-7916). *Applied Physics Letters;* **51**: No. 22, 1845-1847(30 Nov 1987).

We have prepared thin films of Y-Ba-Cu-O superconductors using a pulsed laser evaporation technique. Thin films were formed on (100) Si, (100) MgO, (1-bar102) sapphire, (100) $SrTiO_3$, and amorphous SiO_2 substrates using a XeCl excimer laser ($\lambda = 0.308$ μm, tau = 45 x 10^{-9} s). The depositions were done in an ultrahigh vacuum chamber with pressure of about 10^{-6} Torr during thin-film formation. The deposition by pulsed nanosecond laser irradiation results in stoichiometry close to that of the target. The thickness of the film was controlled by varying the pulse energy density and the number of pulses. The substrate temperature was kept at 470 °C during deposition. Subsequent annealing treatments were carried out at 900 and 650 °C in oxygen atmosphere to recover the superconducting properties of these thin films. The resistance of these films was measured as a function of temperature using the four-point probe method. These thin films were analyzed using cross-section transmission electron microscopy, Rutherford backscattering spectrometry, and channeling techniques. The variation in the oxygen content and the interdiffusion of species into the substrate during subsequent annealing treatments are discussed.

3766 **Process for preparing transition metal nitrides and transition metal carbonitrides and their reaction intermediates.** Maya, L. (to Dept. of Energy). US Patent Application 6-939,920. 9 Dec 1986. 10p. Contract AC05-84OR21400. DE88000849 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000849/JAW.

Disclosed is a process for making ammonolytic precursors to nitride and carbonitride ceramics. Extreme reaction conditions are not required and the precursor is a powder-like substance that produces ceramics of improved purity and morphology upon pyrolysis.

3606 Other Materials

REFER ALSO TO CITATION(S) 3119, 3241, 3248, 3257, 3286, 3358, 3530, 3681, 3707, 3720, 3728, 3736, 3759, 3805, 3833, 3855, 3869, 3870, 3872, 3873, 3874, 3884, 3885, 3886, 3887, 3892, 4223, 4247, 4250, 4310, 5290

3767 **(AD-A—183479/5/XAB) Annealing effects in ion-bombarded GaAs: raman measurements. Technical report No. 3, 1 August 1986-31 July 1987.** Burns, G.; Dacol, F.H.; Wie, C.R.; Burstein, E.; Cardona, M. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). 31 Jul 1987. 10p. NTIS, PC A02/MF A01.

The surface layer of single-crystal GaAs that bombarded with high-energy (2-15 MeV) ions is strained and contains many defects, but it remains crystalline. The isochronal annealing behavior of this layer was studied using phonon shifts and widths, which were detected by Raman measurements. No sharp annealing stages were found to 500 C, at which temperature the phonons returned to their positions in the unbombarded crystals. These results are consistent with the idea that the phonon shifts are primarily due to antisites and their complexes with other primary defects. However, other extended defects may still be present, and the Raman data show some evidence for this.

3768 **(AD-A—183634/5/XAB) Dioxouranium(vi) dicarboxylate polymers: synthesis and characterization of tractable coordination polymers and evidence for rigid-rod confirmation. Technical report.** Hardiman, C.J.; Archer, R.D. (Massachusetts Univ., Amherst (USA). Dept. of Chemistry). 28 Feb 1987. 44p. (TR—7). NTIS, PC A03/MF A01.

A series of polymeric dicarboxylato dioxouranium (VI) species were synthesized via an equilibrium-controlled solution reaction where bis(acetato)dioxouranium (VI) dihydrate undergoes an acid interchange with a dicarboxylic acid. The solution synthesized species have number average molecular weights of up to 1.8×10^4 based on end group analysis, gel-permeation chromatography, inherent viscosity and elemental analysis. The empirical Mark-Houwink relation of viscosity to molecular weight was demonstrated for poly(3,3-dimethyl-pentanedionato)(dimethyl sulfoxide) dioxouranium (VI) which is indicative of rigid-rod conformation. This series was also prepared interfacially where the disodium salt of a dicarboxylic acid in an aqueous phase reacted with bis(nitrato)dioxouranium (VI) hexahydrate in diethyl ether.

3769 **(AD-A—183868/9/XAB) Ceramic-ceramic composites meeting in Belgium. Technical report.** Cartz, L. (Office of Naval Research (USA). London Branch Office). 4 Aug 1987. 7p. (ONRL—7-020-R). NTIS, PC A02/MF A01.

The problems of obtaining homogeneous dispersions of multicomponent systems were frequently discussed at this conference. The use of acoustic emission was shown to be a useful NDT analytical tool to detect the presence of microcracks in different places. The composite systems considered at the meeting included: zirconia-toughened aluminum (ZTA), silicon carbide (SIC) fiber-reinforced pyrex, SiC fiber-reinforced silicon dioxide (SiO_2) glass matrix, mullite-zirconia- Al_2O_3-SiC, C-fiber-reinforced reaction-bonded SiC, ionic conducting NASICON-glass insulator composites, and GAMA A1ON-$A1_2O_3$ composites. The zirconium oxycarbide system, ZrO_2-ZrCxOy and ZrC-ZrCxOy composites are interesting, novel systems.

3770 **(CONF-8705200—1) Fabrication of composites by chemical vapor deposition.** Besmann, T.M.; Lowden, R.A.; Stinton, D.P.; Caputo, A.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014565/JAW.

From Northeast regional meeting of the Metallurgical Society and the Materials Research Society; Hoboken, NJ, USA (27 May 1987).

Processes for the preparation of composite bodies using chemical vapor deposition have been developed. Composites are prepared by infiltrating ceramic fiber preforms, held at elevated temperatures, with reactant gases that decompose to deposit ceramic matrix material between and around the fibers. The ORNL process is a marked improvement over those commonly in use; preforms that previously required weeks to densify now require ~24 h. Specimens with densities up to 90% of theoretical and strengths in the range of 300 MPa have been produced. Most importantly, the materials fail noncatastrophically, exhibiting typical composite behavior. The material produced is SiC matrix in SiC (Nicalon) fibers. 28 refs., 6 figs.

3771 **(CONF-8707120—2-Vugraphs) Theoretical aspects of channeling, damage, and range distributions for low (keV) and high (MeV) energy implantation.** Robinson, M.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000949/JAW.

From SEMATECH strategic planning workshop on advanced ion implantation manufacturing technology for the semiconductor industry; Oak Ridge, TN, USA (20 Jul 1987).

The effects of ion irradiation, ion implantation of silicon in silicon, and channeling are presented in the form of vugraphs, graphs, and charts. (CBS)

3772 **(CONF-8707120—3-Vugraphs) Surface modification using ion beams: Recent developments at ORNL.** Roberto, J.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000951/JAW.

From SEMATECH strategic planning workshop on advanced ion implantation manufacturing technology for the semiconductor industry; Oak Ridge, TN, USA (20 Jul 1987).

A brief description of past and continuing research in ion implantation at ORNL is presented. Included are the objectives and motivation for research in the following areas: fabrication of high energy solar cells, direct ion beam deposition, and ion-implanted optical waveguides. (CBS)

3773 **(CRN-CPR—85-09) Study of low energy hydrogen ion implantation effects in silicon: electric properties.** Barhdadi, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1985. 208p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750478/JAW.

Several analysis methods have been developed: hydrogen distribution analysis by nuclear reaction, crystal disorder evaluation by R.B.S., chemical impurities identification by SIMS, optical measurements, electrical characterization of surface barriers, deep level spectroscopy DLTS, ... All these analyses have been made after implantation then after thermal annealing. A model explaining the effect of implantation then after thermal annealing. A model explaining the effect of implanted hydrogen is proposed, the implantation creates an important quantity of defects in a thin layer near the surface; a chemical attack removes them. In Schottky devices, this layer has a basic role on carrier transport phenomena. Other results are given, some of them allow to give an account of the passivation by hydrogen implantation.

3774 **(DOE/ER/05781—1) Ionic transport and electrical relaxation in glass: Final report.** Moynihan, C.T.; Barkatt, A. (comp.). (Catholic Univ. of America, Washington, DC. Vitreous State Lab.). 28 Sep 1987. Contract AS05-78ER05781. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000887/JAW.

The basic purpose of the work described was to achieve extensive and quantitative understanding of ionic transport processes in melts and glasses by means of a combination of experimental measurements and theoretical modeling. Two major subjects of the study were the mechanism of dielectric relaxation in ionically conducting glasses and the large retardation of ionic transport in mixed alkali systems. 14 refs.

3775 **(DOE/ER/45126—3) Vibrational properties of disordered solids: Far infrared studies: Performance report.** Dutta, J.M. (North Carolina Central Univ., Durham (USA)). 1987. Contract FG05-84ER45126. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001474/JAW.

This report presents the results obtained for this project to this date and briefly projects the additional results expected by the termination date. A two-beam interferometer was used for the measurements of dielectric properties of various materials which includes the low-loss, birefringent crystal quartz and sapphire, several ceramics, plastics, glasses and semiconductors. Low absorption values for mono-crystalline quartz and sapphire provide a baseline with which to compare results for analogous materials which contain substantial amounts of disorder, that is, fused silica and alumina. The latter materials have losses which have several times that of the monocrystalline samples. Mechanisms which gives rise to such enhanced absorption in materials containing disorder are still largely unidentified. The effect of impurities upon the absorption is also evident. Water-free fused silica (Spectrosil-WF) has less than one-half the absorption loss of a common fused silica. The results obtained for the dielectric properties of Al_2O_3 materials indicate that single-crystal sapphire has the lowest loss tangent. The best ceramic alumina samples had losses of approximately a factor of 2 larger when compared to sapphire. 21 refs., 1 fig., 3 tabs.

3776 **(EFI—874-25-86) Materials for acceleration by surface electromagnetic waves.** Arutyunyan, S.G.; Ter-Arutyunyan-Savvidi, N.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700312/JAW.

Recommendation to the choice of materials for accelerating dielectric resonator are elaborated on the basis of a great number of studied literature on optical resistance. A catalog of properties of material perspective for the use in this purpose is made up (CsI, Ge, LiF, SrTiO/sub 3/ and etc, in particular). 49 refs.; 2 figs.

3777 (INIS-BR—874, pp 121) **Development of synthetic graphite resistive elements for sintering furnace.** Otani, C.; Rezende, M.C.; Polidoro, H.A.; Otani, S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Pesquisas e Desenvolvimento). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

The synthetic graphites have been produced using lignin coke, natural graphite and phenolic resin. The bulk density, porosity, flexural strength and eletrical resistivity measurements have been performed on specimens at about 2400/sup 0/C. The performance of these materials, as heating elements, was evaluated in a sintering furnace prototype. This paper reports the fabrication process and the experimental results.

3778 (INIS-mf—11037, pp 34) **Electron curing and vacuum metallization of paper.** O'Neill, J.R. (Vacuflex Pty. Ltd., Marayong, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3779 (INIS-mf—11037, pp 39) **High performance liquid chromatography (HPLC) and field desorption mass spectrometry (FDMS) of low molecular weight poly(methyl methacrylate).** Hope, W.W.; Derrick, P.J.; Willett, G.D.; Rizzardo, A.; Solomon, D.H. (New South Wales Univ., Kensington, Australia. School of Chemistry; Commonwealth Scientific and Industrial Research Organization, Fishermen's Bend, Australia. Div. of Applied Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3780 (INIS-mf—11037, pp 40) **Photochemistry of sulphamic acid treated wool.** Cameron, B.A.; Pailthorpe, M.T. (New South Wales Univ., Kensington, Australia. School of Fibre Science and Technology). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3781 **(SAND—86-2825) Tribological properties of rf-sputtered MoS_2 coatings.** Panitz, J.K.G.; Pope, L.E.; Hills, C.R.; Lyons, J.E.; Staley, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000266/JAW.

We completed a two-part study of the effects of: (1) substrate temperature; (2) substrate bias; (3) post-deposition annealing; and (4) the presence of a Cr_3Si_2 undercoating on the tribological properties of 300 to 500 nm MoS_2 coatings which were deposited on annealed 304 stainless steel substrates. We used two-level factorial statistical analysis to identify the relative importance of and parametric interactions between the above parameters. A Cr_3Si_2 undercoating and substrate bias are the most important individual factors in order to obtain MoS_2 coatings with low coefficients of friction, 0.07, in lab air. The highest coefficients of friction, 0.12, occurred for coatings which were not heated during deposition nor annealed afterwards and which were deposited onto substrates that were not biased during deposition or precoated with Cr_3Si_2. The coatings which were deposited onto substrates that were precoated with Cr_3Si_2, subjected to deposition temperatures of 300°C, biased during deposition and annealed afterwards were the most wear resistant. In the second part of this study, we used the three deposition conditions that resulted in superior MoS_2 coatings (300°C substrate temperature, a Cr_3Si_2 underlayer and post-deposition vacuum annealing) and systematically varied the substrate bias from 0 V to -150 V to determine the optimal bias voltage. This indicated the best MoS_2 coatings with regards to both the coefficient of friction and wear life occurred for substrate biases ranging from -50 to -100 V. 18 refs., 6 figs., 1 tab.

3782 **(SAND—87-0285C) The role of hydrogen in radiation-induced defect formation in polysilicon gate MOS devices.** Schwank, J.R.; Fleetwood, D.M.; Winokur, P.S.; Dressendorfer, P.V.; Turpin, D.C.; Sanders, D.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 19p. (CONF-870724—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012374/JAW.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

The role of hydrogen in the generation of radiation-induced interface-trap and oxide-trapped charge in MOS polysilicon gate capacitors has been investigated. The concentration of radiation-induced interface-trap and oxide-trapped charge measured both immediately after irradiation and after postirradiation anneal increases if high temperature anneals are performed in hydrogen. We have analyzed these results in the context of several models of interface-trap and oxide-trapped charge formation. The mutual increase in the concentration of oxide-trapped charge and the early-time (1 msec to 10 sec) component of interface-trap charge with the amount of hydrogen used during processing suggests that the breaking of Si-H or Si-OH bonds may be responsible for much of the defect formation at or near the silicon/silicon dioxide interface. 29 refs., 7 figs.

3783 **(SAND—87-0432C) Analysis of end stresses in glass-metal bimaterial strips.** Gerstle, F.P. Jr.; Chambers, R.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 40p. (CONF-871207—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87007848/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

We have analyzed the shear and normal residual stresses which build up along the interface near the end of a glass-metal seal during cooling. These stresses strongly affect the measured strength of a seal. Previous treatments of this problem have identified the presence of large interfacial transverse normal and shear stresses at the ends of bimaterial joints. We show the presence of maxima and minima in both force and moment. We demonstrate that, for certain material property combinations and relative thicknesses, the interfacial moment can induce either a peel or a pinch

condition at the ends of this strip. We tested this with strips of high expansion glass-ceramic sealed to 304 stainless steel and obtained qualitative agreement. Careful finite element modeling of the strips showed that peel and pinch conditions do not necessarily coincide with the sign of the singular transverse normal stress at the strip end. This sign appears to be controlled by differences in thermoelastic properties and not by relative thickness. 13 refs., 15 figs., 3 tabs.

3784 **(SAND—87-1691C) Novel heterojunction devices.** Narayanamurti, V. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 2p. (CONF-871220—1). NTIS, PC A02. Order Number DE87013716/JAW.

From Institute of Electrical and Electronics Engineering international electron devices meeting; Washington, DC, USA (6 Dec 1987).

Recent progress in the fabrication and realization of novel heterojunction devices based on band structure engineering is described. The fact that strained layer epitaxy can be used to create entirely new structures illustrated through such diverse examples as ordered growth of Ge/Si on Si, strained p-type quantum well FETs with light-hole dominated transconductance on GaAs, and high speed strained InGaAs/GaAs MODFETs. Recent calculations involving molecular dynamic simulations of strained layer growth, with mismatches of up to 4%, is described and the outstanding puzzle of crystal thicknesses much larger than allowed by equilibrium theories for coherent crystal growth is resolved. Some recent examples of the perfection of quantum well structures is illustrated through the fabrication of devices based on perpendicular transport such as the resonant tunneling bipolar transistor and 10 μm superlattice ir detectors. 8 refs.

3785 **(SAND—87-2025C) The tribological properties of MoS_2 coatings in vacuum, low relative humidity and high relative humidity environments.** Panitz, J.K.G.; Pope, L.E.; Lyons, J.E.; Staley, D.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-871125—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001611/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

We have rf-sputter deposited MoS_2 coatings onto stainless steel plates using two extremal combinations of deposition conditions. Raman spectroscopy indicates that there is a small but significant difference in the number of sulfur-sulfur bonds and the amount of amorphous material present in the two types of coatings. The friction and wear properties were evaluated within 5 days of deposition, and after being stored for 150 days in 35 to 45% relative humidity followed by over 75 days in 2% or 98% relative humidity environments. For lab air testing the coefficient of friction increased with wet storage to 0.10 +- 0.01, and the wear life decreased by a factor of three for dry storage and by a factor of ten for wet storage. The MoS_2 material with the larger amount of amorphous material has a coefficient of friction of 0.10 +- 0.013 which increased to 0.14 +- 0.04 for storage in the wet environment. The wear life of the MoS_2 coating with the greater amount of amorphous material improved significantly (by 100%) for storage in the wet environment. 31 refs., 3 figs., 2 tabs.

3786 **(SJE—8503) Hydrodynamics of polymers in solution. Final report.** James, D.F.; Chesneau, C.P.; Kimbell, D.G.; Fraser, C.R. (S and J Engineering, Inc., Toronto, Ontario (Canada)). Mar 1985. 168p. (MICROLOG—85-5925). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This document consists of two separate reports. The first deals with theoretical work to predict the permeability of fibrous porous media, and the second describes experiments to measure the permeability of entangled polymer chains in solution. The relationship between pressure drop over some length and discharge velocity through fibrous porous media, or permeability, is theoretically investigated. A mathematical model is proposed to represent low inertia flow past the fibers of these media. The permeability of a concentrated polymer solution was determined by confining the solution between solvent-permeable membranes in a test cell and measuring the pressure drop across the cell at known flow rates. From the data, the permeability of the solution was determined from Darcy's Law. 18 figs.

3787 **Rapid lattice expansion and increased x-ray reflectivity of a multilayer structure due to pulsed laser heating.** Zigler, A.; Underwood, J.H.; Zhu, J.; Falcone, R.W. (Physics Department, University of California at Berkeley, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 23, 1873-1875(7 Dec 1987).

The spacing of layers in a sputtered, multilayer structure was rapidly and permanently increased by heating with a nanosecond laser pulse. During laser heating, the Bragg angle decreased and the peak reflectivity increased for diffraction of soft x-ray radiation at 4.4 nm. Measurements were made using a time and space resolving x-ray streak camera detector.

3788 **Optical investigation of highly strained InGaAs-GaAs multiple quantum wells.** Ji, G.; Huang, D.; Reddy, U.K.; Henderson, T.S.; Houdre, R.; Morkoc, H. (University of Illinois at Urbana-Champaign, Coordinated Science Laboratory, 1101 W. Springfield Ave., Urbana, Illinois 61801). *Journal of Applied Physics;* **62**: No. 8, 3366-3373(15 Oct 1987).

Low-temperature optical transmission spectra of several In/sub x/Ga/sub 1-//sub x/As/GaAs strained multiple quantum wells (MQWs) with different well widths and In mole fractions have been measured. The excitonic transitions up to 3C-3H are observed. The notation nc-mH(L) is used to indicate the transitions related to the nth conduction and mth valence heavy (light) hole subbands. Steplike structures corresponding to band-to-band transitions are also observed, which are identified as 1C-1L transitions. The calculated transition energies, taking into account both the strain and the quantum well effects, are in good agreement with the measured values. In these calculations the lattice mismatch between the GaAs buffer and the InGaAs/GaAs MQW is taken into account and the valence-band offset Q/sub v/ is chosen as an adjustable parameter. By fitting the experimental results to our calculations, we conclude that the light holes are in GaAs barrier region (type II MQW) and the valence-band offset Q/sub v/ is determined to be 0.30. A possible system in which the transition from type I to type II for light holes might be observed is also discussed.

3789 **Synchrotron-radiation study of the five-dimensional modulated phase of tetrathiafulvalene-tetracyanoquinodimethane (TTF-TCNQ) at 15 K.** Coppens, P.; Petricek, V.; Levendis, D.; Larsen, F.K.; Paturle, A.; Yan, G.; LeGrand, A.D. (Chemistry Department, State University of New York at Buffalo, Buffalo, New York 14214). *Physical Review Letters;* **59**: No. 15, 1695-1697(12 Oct 1987).

The 2k/sub F/ modulated structure of tetrathiafulvalene-tetracyanoquinodimethane (TTF-TCNQ) at 15 K has been analyzed by use of a set of satellite intensities collected at the National Synchrotron Light Source. The analysis in the five-dimensional superspace group $P:P2_1/c:cmm$ shows the largest modulation to be a slip of the TTF molecules with an amplitude of about 0.02 A, in the direction of the long molecular axis of the molecule. The TCNQ translational modulations are similar, but of much smaller magnitude . Rotations about the long molecular axes of both type of molecules are also observed.

3790 **Structural alterations in the amorphous-to-crystalline transformation of lead pyrophosphate.** Sales, B.C.; Ramey, J.O.; Boatner, L.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **59**: No. 15, 1718-1721(12 Oct 1987). Contract AC05-84OR21400.

The detailed structural changes that occur during the isothermal transition from a glass to a single-phase crystalline solid have been determined for the first time by use of the modern technique of high-performance liquid chromatography. Quantitative measurements of the evolution of the type and relative concentration of individual structural units present during the devitrification process were made on lead pyrophosphate glasses annealed below, at, and above the glass transition temperature.

3791 **Role of experimental resolution in measurements of critical layer thickness for strained-layer epitaxy.** Fritz, I.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* 51: No. 14, 1080-1082(5 Oct 1987). Contract AC04-76DP00789.

Experimental measurements of critical layer thicknesses (CLT's) in strained-layer epitaxy are considered. Finite experimental resolution can have a major effect on measured CLT's and can easily lead to spurious results. The theoretical approach to critical layer thicknesses of J. W. Matthews [J. Vac. Sci. Technol. 12, 126 (1975)] has been modified in a straightforward way to predict the apparent critical thickness for an experiment with finite resolution in lattice parameter. The theory has also been modified to account for the general empirical result that fewer misfit dislocations are generated than predicted by equilibrium calculation. The resulting expression is fit to recent x-ray diffraction data on InGaAs/GaAs and SiGe/Si. The results suggest that CLT's in these systems may not be significantly larger than predicted by equilibrium theory, in agreement with high-resolution measurements.

3792 **Strained-layer superlattices.** Peercy, P.S.; Osbourn, G.C. (Compound Semiconductor and Device Research Dept. at Sandia National Labs.). *Journal of Metals;* 39: No. 6, 14-18(Jun 1987). Contract AC04-76DP00789.

High-quality superlattices are grown from semiconductor materials with lattice mismatches of several percent for sufficiently thin layers. These strain-layer superlattices provide previously unexploited freedom in the choice of materials and thus the ability to tailor the resulting electrical and optical properties. Such artificially structured materials not only open up entirely new areas of materials science, but also permit the development of novel devices with new or improved characteristics. After a brief review of the history of SLS's, recent results in these areas, along with devices based on the unique properties of these structures, are illustrated.

3793 **(AAEC-LIB/Trans—800) Remarks on radiation-induced phase conversion in barium titanate.** Schenk, M. Translated from *Naturwissenschaften ;* 19: 537-538(1965). 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700294/JAW.

Translated from German.

This paper reports on investigations into the crystallography of radiation-induced phase conversions. Poly-crystalline, tetragonal BaTiO/sub 3/, mono-clinic CaTiO/sub 3/, cubic SrTiO/sub 3/ and cubic stabilised BaTiO/sub 3/ were irradiated under various conditions in the Rossendorf research reactor. The experiments indicated that several types of defect occurred side by side of which oxygen defects constituted the largest proportion.

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3794 **(BNL—52103) Abstracts for new opportunities in chemistry: An international symposium on the uses of synchrotron radiation in chemistry, November 4-6, 1987.** (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 138p. (CONF-871145—Absts.). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001957/JAW.

From International symposium on new opportunities in chemistry: the uses of synchrotron radiation in chemistry; Upton, NY, USA (4 Nov 1987).

Seventy-eight summaries of presentations are included. (DLC)

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REFER ALSO TO CITATION(S) 2802, 3182, 3741, 3779, 3848, 3849, 4005, 4007, 4249, 4276, 4292, 4627

3795 **(AD-A—183584/2/XAB) High-temperature sample holder for fast-atom-bombardment mass spectrometry of molten materials. Technical report, October 1986-October 1987.** Doyle, R.J. (Naval Research Lab., Washington, DC (USA)). 30 Jul 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Analytical Chemistry, 537-539(1 Feb 1987).

A new, high-temperature, sample holder for fast-atom bombardment (FEB) mass spectrometry of vitreous materials is described. The sample holder is capable of heating FAB samples to 620 C without modification of the FAB probe ion source. High-temperature sample introduction is useful in removing occluded water and water-sample reaction products from hygroscopic materials that will otherwise interfere with isotope-ratio measurements and mass spectrometry-mass spectrometry experiments. FAB mass spectra of B_2O_3 (boron trioxide), taken at sample temperatures of 30 and 550 C, are presented for comparison. The spectra demonstrate that protonated and hydrated species that interfere with isotope-ratio measurements are eliminated at the high sample temperatures achievable with this sample holder.

3796 **(AERE-R—12467) Trial of thin layer activated weight loss coupons for corrosion monitoring in oilfield applications.** Asher, J.; Lawrence, P.F.; Sugden, S. (UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.). Mar 1987. 13p. H.M. Stationery Office, London, price Pound 4.00.

A set of thin layer activated weight loss corrosion coupons was installed in the wellheads and flow lines of oil production platforms in the North Sea. The coupons were retrieved for laboratory analysis after about six months of exposure. A comparison is made between the results obtained by TLA analysis and standard weight loss measurements. Samples of scale deposits on some of the fittings used were also analysed.

3797 **(ANL—87-34) Measuring the absolute disintegration rate of a radioactive gas with a moveable endplate discharge counter (MEP) and theoretical calculation of wall effect.** Jaffey, A.H.; Gray, J.; Bentley, W.C.; Lerner, J.L. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001956/JAW.

A precision built moveable endplate Geiger-Mueller counter was used to measure the absolute disintegration rate of a beta-emitting radioactive gas. A Geiger-Mueller counter used for measuring gaseous radioactivity has <100% counting efficiency owing to two factors: (1) "end effect," due to decreased and distorted fields at the ends where wire-insulator joints are placed, and (2) "wall effect," due to non-ionization by beta particles emitted near to and heading into the wall. The end effect was evaluated by making one end of the counter movable and measuring counting rates at a number of endplate positions. Much of the wall effect was calculated theoretically, based on known data for primary ionization of electrons as a function of energy and gas composition. Corrections were then made for the "shakeoff" effect in beta decay and for backscattering of electrons from the counter wall. Measurements and calculations were made for a sample of ^{85}Kr (beta energy, 0.67 MeV). The wall effect calculation is readily extendable to other beta energies.

3798 **(BARC—1329) Optical emission spectrographic analysis of lutetium oxide for rare earth impurities.** Chandola, L.C.; Dixit, V.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700298/JAW.

An optical emission spectrographic (OES) method has been developed for the analysis of high purity lutetium oxide to determine rare earths Er, Tm, Yb and Y. The spectra are excited by a d.c. arc run at 10 A current after mixing the sample with graphite buffer in the weight ratio 1:1. A 1200 grooves/mm grating blazed at 3300 A is used for dispersion and a Kodak SA-1 plate for recording the spectrum. The detection limit is 0.001 per cent for Tm, Yb and Y while it is 0.005 per cent for Er. The relative standard deviation of the method is +- 13.4 per cent. 6 tables, 4 figures, 3 refs.

3799 **(BARC—1334) Trace metal assay of fast breeder test reactor fuel using DC arc and plasma emission spectrometry.** Page, A.G.; Dalvi, A.G.I.; Godbole, S.V.; Babu, Y.; Seshagiri, T.K.; Sastry, M.D. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700301/JAW.

This report describes the methods developed and used for the trace metal assay of the first charge of the FBTR fuel using a

glove-box adapted direct reading emission spectrometer. The group of medium and highly volatile elements are determined in (U,Pu)C fuel samples by d.c. arc carrier distillation technique while the group of lanthanide elements are determined by ICP excitation mode with prior chemical separation from the major matrix. The statistical treatment of the analytical data collected from the analysis of about one hundred samples has indicated good purity of samples and consistent and satisfactory performance of the direct reading spectrometer and associated systems during this period. 5 tables, 7 refs.

3800 **(BNL—40295) X-ray fluorescence proportional counter for SEXAFS studies of low-Z adsorbates.** Fischer, D.A.; Hastings, J.B.; Zaera, F.; Stoehr, J.; Sette, F. (Brookhaven National Lab., Upton, NY (USA); Exxon Research and Engineering Co., Annandale, NJ (USA). Corporate Research Science Lab.; Bell Labs., Murray Hill, NJ (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850734—27). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001559/JAW.

From 2. international synchrotron radiation instrumentation conference; Stanford, CA, USA (29 Jul 1985).

An ultrahigh-vacuum-compatible x-ray detector for fluorescence yield (FY) surface EXAFS of low-Z adsorbates is described. For chemisorbed submonolayer (ML) sulfur on Ni(100) this detector is shown to offer nearly an order of magnitude increase in surface sensitivity and comparable signal-to-noise as compared with any conventional electron yield detector. The FY detector allows one to record SEXAFS spectra for 1/100 ML of S on Ni(100) corresponding to a concentration of 1 ppM S in bulk Ni. A design for a second generation UHV FY proportional counter for the detection of C and O K α radiation is described and initial results are presented. The FY SEXAFS technique for low-Z adsorbates is shown to overcome the limitations of electron yield techniques such as interfering photoemission peaks and normalization problems. 9 refs.

3801 **(CEA-CONF—8946) Control of the mass of a plutonium sample by neutron coincidences with correction of induced fissions.** Bessis, J.; Thaurel, B.; Monier, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire). Nov 1986. 18p. (In French). (IAEA-SM—293/4; CONF-861104—16). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750097/JAW.

From International symposium on nuclear material safeguards; Vienna, Austria (10 Nov 1986).

When the isotopic composition of nuclear materials to control is known, it is possible to determine the amount of plutonium by measuring the rate of spontaneous fissions. The induced fissions alter significantly the measures. Therefore we must evaluate the multiplicative factor. For a not very multiplicative sample, the observed neutron coincidences of multiplicity 0 to n agree with spontaneous emissions given by nuclear tables. This is not true in the opposite case (large amounts). Multiplicities are given by eighteen counting-scales associated with a shift-register coincidence system (SCRD) and compared with theoretical spontaneous emissions of the sample. A calculator leads all equipment and compares theoretical and experimental results about the controlled amount of Pu.

3802 **(DOE/ER/13487—2) Study of the properties of a new detector class for liquid chromatography: Progress report.** (Georgetown Univ., Washington, DC (USA)). 1987. Contract FG05-86ER13487. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001666/JAW.

The principle of the evaporative light scattering detector (ELSD) detector is that of a transport detector, using a scavenger gas stream rather than a material conveyor. The effluent is nebulized immediately at the exit of the chromatographic column, in a concentric nebulizer, in a stream of warm gas. The solvent vaporizes and leaves a cloud of particles made by the non-volatile content of the eluate. This contains the solutes, as well as the non-volatile residue of the solvent. These particles are carried by the gas stream across an intense light beam. The amount of scattered light collected on a photocell or a photomultiplier is a measure of the amount of non-volatile solute in the effluent stream. A systematic study of the influence of the detector parameters on its response was undertaken, with emphasis on the nebulizer design and operation. This is of special importance in the case of the ELSD, because of some of its particular properties and because of contradictions found in the literature. 13 refs., 8 figs., 10 tabs.

3803 **(DP-MS—87-100) Online fiber-optic spectrophotometry.** O'Rourke, P.E.; Van Hare, D.R. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 33p. (CONF-8710168—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001378/JAW.

From Du Pont process analyzers and instruments symposium; Wilmington, DE, USA (14 Oct 1987).

To improve the timeliness of chemical information and reduce the potential for personnel radiation exposure, the Savannah River Laboratory has developed online absorption spectrophotometers. Absorption spectrophotometers are rugged, precise instruments which, however, are susceptible to interference from other optically absorbing species and to changes in analyte absorbance due to different matrixes. Also, it is difficult and expensive to interface absorption spectrophotometers to SRP's radioactive processes. The fiber-optic spectrophotometer described solves these problems by combining three technologies: fiber optics, diode array spectrophotometers, and multivariate data analysis. A multiplexed fiber-optic light transmission system connects as many as ten process sample locations to a single remote spectrophotometer up to 100 meters distant. In addition to the sample locations, the spectrophotometer is also connected to reference and standard optical cells for online data validation and error checking. For each sample location, the spectrophotometer rapidly collects a series of absorption spectra from 300 to 820 nm. Spectra are tested for sample quality and integrity before analyte concentrations and residual spectra are computed from a multivariate model of the absorption characteristics of the chemical system. Residual spectra are tested to determine if any unknown interference or matrix effect may invalidate concentration results.

3804 **(IAEA-RL—145) Report on intercomparison exercise SR-74 determination of impurities in U/sub 3/O/sub 8/.** Doubek, N.; Deron, S. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). Jun 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700017/JAW.

The report presents results of a laboratory intercomparison of the determination of impurities in U/sub 3/O/sub 8/ sample organized by the IAEA. Seven laboratories of six countries, sent their results regarding 31 elements. The evaluation was based on 121 laboratory means. The majority of the results were obtained by emission spectroscopy and by flame atomic absorption techniques. As a result of this intercomparison, recommended certification values can be assigned for the concentration of Cr, Cu and Mg. Information values can be provided for an additional twelve elements (Al, B, Co, Fe, Mn, Mo, Ni, P, Pb, Sn, V, and Zn). 5 refs, 14 figs, 33 tabs.

3805 **(INIS-BR—874, pp 509) Determination of the end of preinduction period of cement, via X-ray diffraction.** Greca, M.C. (Instituto Nacional de Tecnologia, Rio de Janeiro, Brazil. Lab. de Raios-X). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

A methodological analysis to determine the end of the preinduction period of cement, via X-ray diffraction of ettringite characterization, was developed. Ordinaries portlands cements (OPC) samples were analysed 'in natura' and after water and acetone additions. The acetone was added at diferent time intervals to interrupt the hydration reactions and in order to perform the analysis. Detailed experimental steps are included.

3806 **(INIS-BR—894) Complexes preparation and spectroscopic with Ln (Et/sub 2/ NCS/sub 2/)/sub 3/ general formula.** Silva, A.M. da; Brandao, E.G.N.; Melo, S.M. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700427/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

A different method for the Ln (Et/sub 2/NCS/sub 2/)/sub 3/ complexes synthesis was developed. In the diethylamine and carbon dissulfite reaction, the diethylcarbamate was prepared. This salt was dissolved in ethanol and a lanthadic salt (choride or perchloride) was added and the complex was obtained. (L.M.J.).

3807 **(INIS-mf—10725) Utilization of boron irradiation filters in reactor neutron activation via epithermal (n,γ) and fast neutron reactions. Application to biological matrices.** Chisela, F. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Physik). 19 Aug 1986. 157p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750156/JAW.

The technique of instrumental neutron activation analysis based on irradiation with reactor epithermal and fast neutrons has been described and evaluated. Important characteristics of boron neutron absorbers used to remove thermal neutrons from the reactor neutron spectrum have been examined and compared with those of cadmium. Three boron compound shields, have been designed and constructed at the BER II 5MW reactor for use in epithermal neutron activation analysis of biological materials. The major advantages offered by these filters in this application include the flexibility of varying the filter thickness, the low radioactivity induced in the filters during irradiation, ease of fabrication and the relatively low cost of the filter materials. The radiation heating due to the / sup 10/B(n,α)/sup 7/Li-reaction has been experimentally investigated for the filters used and the results obtained confirm the necessity for efficient cooling of these filters during irradiation. Three irradiation facilities have been characterized with respect to the neutron flux density and the flux spatial distribution. An experiment has been designed and carried out to compensate the flux inhomogeneity in two irradiation positions of the DBV facility caused by the reactor geometry. Several biological samples including well characterized reference materials have been analysed after epithermal activation and the results compared with those obtained with the classical thermal neutron activation method. Improved sensitivity of determination has been found for elements with high resonance integral to thermal neutron cross section ratios (RI/σ/sub 0/). The range of elements that can be determined instrumentally is extended and the time scale of analysis is considerably reduced.

3808 (INIS-mf—10730, pp 117-121) **Non-destructive biomass assay using radiometric methods.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The author reports on studies performed on large-sized plants for continuous and non-destructive measurement of biomass and water mass using gamma rays and microwaves. Kohlrabi bulbs were used in these studies owing to their approximate spherical symmetry. The results obtained allow conclusions to be drawn for the growth process of the kohlrabi plants.

3809 (INIS-mf—11045, pp 225-252) **Cesium extraction from reactor pool water using supported liquid membranes.** Craig, W.M.; Hofman, D.L.; Buchalter, E.M.; Birkill, R.S.; Smit, J.J. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; Potchefstroom Univ. for C.H.E., South Africa). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

Cesium 137 is one of the fission products contaminating reactor pool water either by diffusion through the cladding or from leaks in fuel elements. In the conventional purification of the pool water, resins are used to remove the fission products. Recovery of these elements from the resin is, however, very difficult. Recovery of cesium 137, in particular, would be very advantageous. In this paper it is proposed that the fission products be removed, from the pool water, firstly by concentration of the solution, using reverse osmosis, and then by selective removal of the elements from the concentrate using a supported liquid membrane. Experimental results show that a PVDF membrane, impregnated with BAMBP and traces of a crown ether, used between a feed solution at pH 10 and diluted nitric acid as strip solution, selectively recovers 6g of cesium per square metre in a seven day period.

3810 **(K/PS—5078) A cathodic stripping technique for the determination of trace levels of arsenic and selenium in waste, organic, and environmental samples.** Powell, M.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 14 Oct 1987. Contract AC05-84OT21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002257/JAW.

This paper describes a sensitive, accurate method based on electrochemical cathodic stripping to determine trace levels of arsenic and selenium. Advantage of this technique is the ability to preconcentrate the elements at the mercury electrode as mercury complexes. These compounds can then be stripped back into the supporting electrolyte of HCl with the resulting current proportional to the concentration. A PARC model 384B polarographic analyzer with multiple 303A static drop mercury electrodes was used to analyze samples with detection limits of 0.005 mg/L for both arsenic and selenium. The primary obstacle to the use of high sensitivity voltammetric analysis has been high background currents caused by the presence of electroactive substances in the sample matrix. In order to eliminate this problem, sample preparations consist of a perchloric/nitric acid digestion for aqueous samples, or oxygen bomb digestion for organic samples. These techniques have proven satisfactory for most samples and result in a sample matrix that is satisfactory for voltammetric analysis. An anion/cation ion exchange technique has been developed to eliminate background problems. In addition, the ion exchange eliminates direct interference from metals such as copper, lead, and tin.

3811 **(LA—11007-T) Using solvent extraction to process nitrate anion exchange column effluents.** Yarbro, S.L. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002175/JAW.

Octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO), a new organophosphorous extractant, and a new centrifugal mixer-settler both recently developed at Argonne were evaluated for their potential use in the recovery of actinides from nitrate anion exchange column effluents. The performance of the extractant was evaluated by measuring the extraction coefficient values as a function of acid and salt concentration. Additional performance parameters include extraction coefficient behavior as a function of the total metal concentration in the organic phase, and comparison of different stripping and organic scrubbing techniques. A simulated effluent stream was used to evaluate the performance of the centrifugal mixer-settlers by comparing experimental and calculated interstage concentration profiles. Both the CMPO extractant and the centrifugal mixer-settlers have potential for processing nitrate column effluents, particularly if the stripping behavior can be improved. Details of the proposed process are presented in the flowsheet and contactor design analyses.

3812 **(LA—11008-MS) Chemical analysis for excimer laser systems.** Heaton, R.C.; Hemberger, P.H.; Sandoval, W.F. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001941/JAW.

Analytical methods and procedures used to determine fluorine, krypton, xenon, and argon in fill gases for excimer lasers are described. Fluorine was determined by gas chromatography, mass spectrometry, and wet chemical (iodine liberation) methods. The noble gases were determined by gas chromatography and mass spectrometry, and attempts to identify impurities were made using mass spectrometry. Analytical results for 26 gas cylinders are re-

ported. Limitations of the methods are discussed and recommendations for future efforts are presented.

3813 (NEI-DK—39, pp 87) **Determination of ionisation constants of radiopharmaceuticals by HPLC using simple buffered aqueous mobile phases.** Theobald, A.E.; Stylli, C.G.; Thorback, J.D. (Department of Pharmacy, Kings College, London, GB; Chemistry Department, Loughborough University, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3814 (NEI-NO—24) **Electrochemical preconcentration and hydride generation methods for trace determination of selenium by atomic absorption spectrometry.** Bye, R. (Oslo Univ. (Norway)). 1986. 90p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753033/JAW.

The use of atomic absorption spectrometry in combination with two different preconcentration/separation techniques for the determination of trace concentrations of selenium is described. Electrochemical preconcentration onto a platinum electrode with a subsequent atomization of selenium is discussed briefly. Several parameters are considered such as the presence of depolarizers, and the temperature of the electrolyzed solutions. Special attention is payed to the efficiency of the atomization step, and a method to improve this is proposed. Applications of the technique to real samples are also reported. Secondly, the separation of the selenium as the volatile selenium hydride from the sample solution is considered. Several papers in this thesis deal with commonly occurring interferants as nickel and copper and with ways of minimizing or avoiding the interferring effects, whereas other papers relate to more theoretical aspects of the hydride generation process. New methods for the determination of selenium in technical samples with high contents of nickel and copper are also presented. 45 refs. Reprints of 17 previously published papers.

3815 (OEFZS—4399) **Isotope ratio analysis by a combination of element analyzer and mass spectrometer. Application to food control and environmental research.** Pichlmayer, F. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1987. 16p. (In German). (LA—182/87). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700064/JAW.

The use of stable isotope ratios of carbon, nitrogen and sulfur as analytical tool in many fields of research is of growing interest. A method has therefore been developed, consisting in essential of coupling an Elemental Analyzer with an Isotope Mass Spectrometer, which enables the gas preparation of carbon dioxide, nitrogen and sulfur dioxide from any solid or liquid sample in a fast and easy way. Results of carbon isotope measurements in food analysis are presented, whereat it is possible to check origin and treatment of sugar, oils, fats, mineral waters, spirituous liquors etc. and to detect adulterations as well. Also applications in the field of environmental research are given.

3816 (STUK-A—52) **Independent burnup verification of BWR-type nuclear fuel by means of the /sup 137/Cs activity.** Ekenstam, G. af; Tarvainen, M. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jun 1987. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753047/JAW.

For independent verification of spent BWR fuel, a nondestructive assay (NDA) method has been developed in co-operation with the Finnish Centre for Radiation and Nuclear Safety (STUK) and the Swediah Nuclear Power Inspectorate (SKI). The verification method is based on the high resolution gamma spectrometric (HRGS) detection of the 662 keV gamma emission of /sup 137/Cs. The assemblies, square in form, are measured by constant speed scanning on each of the four corners. A calibration line, /sup 137/Cs-activity versus burnup (BU), was defined. As part of the project, a novel type of transportable /sup 137/Cs-calibration source was constructed and demonstrated to work very satisfactorily. Measurements were carried out in three commercial nuclear power plants and one separate spent fuel storage. The measured assemblies had BU from 14 to 41 MWd/kgU and cooling time (CT) from 150 to 1500 days. After correction and normalization it was possible to compare all measured assemblies with each other. Consistency between the measured and the declared values is good. In addition to 41 normal assemblies the method was succesfully tested with 6 assemblies to reveal that two of them were incomplete.

3817 (ZE—870330) **Development of a rapid GC/MS method for type characterization of petroleum hydrocarbons using a Finnigan 4500 GC/MS. Final report.** (Zenon Environmental, Inc., Burlington, Ontario (Canada)). 30 Mar 1987. 209p. (MICROLOG—87-04036). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Following the completion of a feasibility study, concentration in this study was software development, installation, and testing to evaluate the resulting data from a Finnigan 4500 running a version of Robinson's hydrocarbon typing method. The evaluation was to focus on repeatability and comparability of data. The Robinson method was converted. 2 figs., 16 tabs.

3818 **Separation of silica from spent geothermal fluids by adsorptive bubble techniques.** De Carlo, E.H.; Ronay, C. (Univ. of Hawaii, Honolulu). *Separation Science and Technology;* **22**: No. 4, 1293-1311(1987).

A method is described for the separation of amorphous silica from super-saturated high ionic strength geothermal fluids produced by the Hawaii Geothermal Project Well-A. A bench-scale technique which makes use of adsorptive bubble flotation is employed to remove silica after flocculation by the addition of polyvalent metal ions to hot (60-90°C) spent brine discharge. Ferric and aluminum salts are evaluated as flocculants under varying conditions. The anionic surfactant sodium lauryl sulfate and the cationic surfactant lauryl amine hydrochloride (LA) are utilized as the collectors below and above the isoelectric point, respectively. Efficiency of removal of the silica is pH, metal concentration, and surfactant-type dependent. Best results are achieved under slightly alkaline conditions (pH = 8), using 3.75 x $10E^{-4}$ M ferric ion present as its sulfate, La as the collector, and with a gas flow of 15 +/- 3 mL/min. Under these conditions, approximately 70 +/- 2% of the total silica is separated from the brine discharge; this value, although not quantitative, represents more than 85% removal of the silica present above its amorphous solubility at the operating temperature. After the separation process, fluids contain residual concentrations of silica which are not expected to result in scale deposition and which can then be passed through heat exchangers to extract further energy for secondary uses.

3819 **Resonantly enhanced collisional ionization measurements of radionuclides.** Whitaker, T.J.; Bushaw, B.A.; Gerke, G.K. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 9.1 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The authors developed a new laser technique to analyze for radionuclides at extremely low levels. The technique, called resonantly enhanced collisional ionization (RECI), uses two nitrogen-laser pumped dye lasers to excite the target isotope to a high-energy Rydberg state. Atoms in these Rydberg states (within a few hundred wavenumbers in energy from the ionization threshold) efficiently ionize upon colliding with an inert gas and the ions can be detected by conventional means. The principal advantage of resonantly-enhanced collisional ionization is the extreme sensitivity coupled with its relative simplicity and low cost. Actinides typically have an ionization potential of about 6eV (uranium I.P. = 6.2 eV, plutonium I.P. = 5.7 eV). Two-step laser excitation to a state just below threshold requires wavelengths in the blue region of the visible spectrum. They showed that when both steps in the excitation process are resonant steps, relatively low-power lasers can populate the Rydberg state with almost unit efficiency. This is because the resonant excitations have much larger cross-sections than do pho-

toionization processes. They also demonstrated that a few torr of a buffer gas will cause most of the excited-state atoms to be ionized.

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REFER ALSO TO CITATION(S) 2802, 2822, 2836, 3202, 3203, 3207, 3687, 3692, 3766, 3768, 3853, 3889, 3934, 3946, 3947, 3952, 3954, 3974, 3976, 3990, 5154

3820 (BARC—1332) Synthesis of perdeuterophenylacetylene. Kunjappu, J.T.; Prasad, C.V.C.; Gupta, H.M.; Rao, M.H.; Rao, K.N. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700300/JAW.

The relative merits of feasible methods to synthesise phenyl acetylene-d/sup 6/ have been evaluated and a convenient path has been adopted for obtaining it in good isotopic purity. Detailed procedures for preparing the intermediate deuterated compounds like benzene-d/sup 6/ bromobenzene-d/sup 5/, α-phenyl-d/sup 5/-ethanol, phenyl-d/sup 5/-ethylene, styrene dibromide-d/sup 5/, phenyl-d/sup 5/-acetylene, phenyl acetylene-d/sup 6/ and deuterosulphuric acid have been outlined. The infrared spectra of these deutero compounds in carbon tetrachloride solution scanned in sodium chloride liquid cells have been presented and they were used in quantitatively estimating their deuterium content. This compound is of potential use as a target material in nuclear fusion studies. 7 figures, 16 refs.

3821 (DOE/ER/04447—230) Physical-chemical studies of transuranium elements: Progress report for the period April 1, 1985-March 31, 1988. Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1987. Contract AS05-76ER04447. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001673/JAW.

New knowledge is being accumulated in the role of the 5f electrons in the bonding in actinide elements and compounds, the relationships of metallic structures to metallic valence and radius, the extent and magnitude of the actinide contraction, the magnetic, thermodynamic, spectroscopic, and crystallographic properties of these materials as related to general theories, the effect of self-irradiation on chemical and physical properties, the chemical and physical consequences of radioactive decay in the bulk-phase solid state, and in general, the range of validity of the actinide hypothesis. Separate reports are given on: spectrophotometric studies of Cf(III) ions in lanthanide trihalide hosts, new ternary transplutonium chalcogenide halides, Raman spectrometric studies of lanthanide trihalides as function of T or P, and solution calorimetry of californium halides.

3822 (DOE/ER/10855—T2) Metal-support interactions: Their effects upon adsorption, electronic, and activity/selectivity properties of cobalt in CO hydrogenation: Final progress report for the period April 1, 1984 to July 1, 1987. Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA). Catalysis Lab.). 1 Jul 1987. Contract AC02-81ER10855. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000901/JAW.

Cobalt, iron and nickel catalysts find wide application in the fuels and chemical industries, particularly in hydrogenation and hydrotreating reactions. Most commercial catalysts containing these metals consist of a metal or metal oxide phase dispersed throughout a high surface area ceramic carrier or support. Effects of surface structure, dispersion and support on activity and selectivity of the active catalytic phase were assumed until recent times to be of secondary importance. However, in the past decade there was evidence that surface structure/dispersion and metal-support interactions can dramatically influence the adsorption and activity/selectivity properties of the metals in a number of reactions. While it is desirable to study separately the effects of surface structure, dispersion and metal-support interactions, these effects are often interrelated. During the past three years, the BYU Catalysis Laboratory has been involved in an investigation of the interaction of cobalt (and to a lesser extent iron) metal(s) with alumina, silica, titania, and carbon. Results of this investigation over these past three years are summarized in this brief report. 22 refs.

3823 (DOE/ER/40237—T3) Chemistry of gaseous, lower valent actinide halides: Technical progress report. Hildenbrand, D.L.; Lau, K.H. (SRI International, Menlo Park, CA (USA)). 20 May 1987. Contract AC03-85ER40237. 11p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001564/JAW.

Gaseous equilibria in the Th-Br system were investigated; bond dissociation energies were determined. Studies of the vaporization of solid $ThOF_2$ were started. Entropies and structures of UX_4 and ThX_4 (X = halide) are discussed. Sublimation of $ThCl_4$ and the vapor mass spectra were studied. (DLC)

3824 (INIS-BR—891) Complexes between lanthanum salts and the 1,2 - Bis (propilsulfinil) ethane. Holanda, J.A.P.; Andrade, Z.M. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700424/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

The coordination compounds betwen lanthanum nitrates, perchlorates and hexafluorphosphates using the γ-dissulfoxide, where R=C/sub 3/H/sub 1/ (n-propil) is the ligand was studied. (L.M.J.).

3825 (INIS-BR—892) Addition compounds between lanthanium bromides and N,N,N′,N′,-tetramethyldipamide (TMAA). Oliveira, W. de; Isuyama, R.; Felicissimo, A.M.P. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700425/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

By elementary analysis, molar eletrolitic condutance measures, infra-red absorption spectra, emission spectra for Eu (III) derivated and x-rays powder diagrams, the crystal compounds formation through the lanthanum (III) and yttrium bromides and the NNN′N′ tetramethyldipamide was characterized. (L.M.J.).

3826 (INIS-BR—893) Luminescence of doped compounds-Eu (III) and Mn (II) utilization. Novo, J.B.M.; Luiz, J.M.; Stucchi, E.B.; Massabni, A.M.G.; Davolos, M.R. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700426/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

A study by eletronic emission spectroscopy in doped phosphinoxides complexes of Eu (III) and Mn (II) watching the ligants and anions effects and probable energy exchanges is being developed. (L.M.J.).

3827 (INIS-BR—895) Trimethylphosphide isomerization in lanthanum ions presence. Zacharias, M.A.; Massabni, A.M.G. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700428/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

The integration between the trimethylphosphide and the lanthanum ions carry to the formation of solid complexes in a relation of 6:1 where the ligand is the phosphonate that is resultant of the isomerization of trimetylphosphite. By the RMN/sup -1/H and infra-red spectra the products were characterized. (L.M.J.).

3828 (INIS-BR—896) Dextran solution optical activity in Tb (III) ion presence. Vasconcellos, S.S.; Rodrigues, J.F.; Faljoni-Alario, A. (Sociedade Brasileira de Quimica, Sao Paulo). 1984. 2p. (In Portuguese). (CONF-8407198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700429/JAW.

From 2. national symposium on inorganic chemistry; Sao Paulo, Brazil (5 Jul 1984).

Optical activity studies of aqueous solutions of dextrana in presence of Tb (III) or without it shows the complex with the hidroxyl groups of C/sub 2/ and C/sub 3/ of monomeric unit participation is formed. (L.M.J.).

3829 (INIS-mf—11037, pp 41) **Heterogeneous and homogeneous metal catalysed tritiation of nitrobenzene.** Garnett, J.L.; Long, M.A.; Than, C. (New South Wales Univ., Kensington, Australia. School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3830 (INIS-mf—11037, pp 42) **Isotopic studies of methanol conversion and related reactions over zeolites.** Kennedy, E. (New South Wales Univ., Kensington, Australia. School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3831 (INIS-mf—11037, pp 45) **Determination of ion recombination rate parameters for rare gas cations with halide ions.** Mezyk, S.; Cooper, R. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3832 (LBL—23923) **The coupled cluster single and double excitation (CCSD) method in quantum chemistry: An efficient formulation of the theory and application to closed shell molecular systems.** Scheiner, A.C. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000475/JAW.

The first chapter discusses successes and outstanding problems in quantum chemistry, the electron correlation problem (the configuration interaction and the coupled cluster approaches), and the truncation of the many-electron expansion. The second chapter gives an efficient formulation of the closed-shell CCSD equations and discusses their application to N_2, H_2O, H_3O^+, $H_5O_2^+$, HSOH, and s-tetrazine ($C_2N_4H_2$). The third chapter is a theoretical study of the electronic states and photodissociation of s-tetrazine. The fourth (and final) chapter gives an efficient formulation of the closed-shell CCSD energy gradient equations, and applies it to the H_2O and H_2CO molecules. 211 refs., 20 tabs. (DLC)

3833 (SAND—87-2321C) **Reactive sticking coefficients of silane on silicon.** Buss, R.J.; Ho, P.; Breiland, W.G.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-871125—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000601/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

We have investigated the reaction of room-temperature silane and disilane on a hot polycrystalline silicon surface using both a collision-free molecular beam and a very low pressure CVD cell. Reactive sticking coefficients were obtained from deposition rate data over a wide range of temperatures and silane (disilane) fluxes. The RSCs are substantially less than one, ranging from 6 x 10^{-5} to 4 x 10^{-2}. For silane we observed curved Arrhenius plots with slopes decreasing from ~60 kcal mol^{-1} at low temperatures to ~2 kcal mol^{-1} at higher temperatures. The RSCs are independent of flux (pressure) at 1040°C, but vary as flux to the ~-1/2 power at 710°C. A model comprised of a dissociative adsorption mechanism with competing associative desorption and reaction was found to give reasonable agreement. For disilane, we observed RSCs that were roughly ten times higher than those for silane. We also observed a curved Arrhenius plot and a flux dependence at 710°C for disilane. 22 refs., 5 figs.

3834 (YJT—87-06) **Review on colloidal systems in general and in respect of nuclear waste disposal.** Vuorinen, U. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Apr 1987. 125p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753051/JAW.

Recently the possible importance of colloids in connection with nuclear waste disposal, especially in radionuclide migration has been emphasized. Several studies have been or are going to be initiated to investigate the occurrence of natural groundwater colloids and their properties as well as formation and properties of radiocolloids, especially pseudoradiocolloids. If colloids are found to be important, they also have to considered in the safety assessments of nuclear waste disposal. In order to do so, additional theory and equations have to be added to present codes and models. This study is a literature survey consisting first a general approach on colloidal systems and their properties. Then a review on natural groundwater colloids (clays and organs) is given following descriptions of several methods to study colloids. Lastly the role of colloids in nuclear waste disposal is discussed including especially some information about possible actinide colloids and some current research going on in this field. 96 refs.

3835 **HTP kinetics studies of the reactions of O(2 ^{3}P/sub J/) atoms with H_2 and D_2 over wide temperature ranges.** Marshall, P.; Fontijn, A. (Department of Chemical Engineering, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *Journal of Chemical Physics;* **87**: No. 12, 6988-6994(15 Dec 1987).

The O+H_2(1) and O+D_2(2) reactions have been investigated, using the high-temperature photochemistry (HTP) technique, over the 350 to 1420 and 390 to 1420 K temperature ranges, respectively. O(2 ^{3}P/sub J/) atoms were generated from flash photolysis of CO_2 and monitored by time-resolved atomic resonance fluorescence with pulse counting. Above 430 K the rate coefficients are given by $k_1(T) = 7.3 \times 10^{-21}$ (T/K)/sup 2.93/ exp(-2980 K/T) cm^3 $molecule^{-1}$ s^{-1} and $k_2(T) = 3.1 \times 10^{-16}$ (T/K)/sup 1.65/ exp (-5260 K/T) cm^3 $molecule^{-1}$ s^{-1}. Combination of our data with those from other experiments which isolated the reactions from secondary processes yields our recommendations $k_1(T) = 1.5 \times 10^{-12}$ exp (-3540 K/T)+3.7 x 10^{-10} exp (-7450 K/T) cm^3 $molecule^{-1}$ s^{-1} (300 K≦T≦2500 K) and $k_2(T) = 1.4 \times 10^{-12}$ exp(-4260 K/T) +2.9 x 10^{-10} exp (-7780 K/T) cm^3 $molecule^{-1}$ s^{-1} (390 K≦T≦1420 K). Accuracy assessments are discussed in the text. $k_1(T)$, $k_2(T)$, and the kinetic isotope effect compare well with calculations based on recent ICVT/LAG and CEQB ab initio methods, which suggest that the first terms of the double exponential expressions approximate the tunneling contributions.

3836 **Comparative study of potential energy surfaces for CH_3/H_2bold-arrow-left-rightCH_4+H.** Steckler, R.; Dykema, K.J.; Brown, F.B.; Hancock, G.C.; Truhlar, D.G.; Valencich, T. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **87**: No. 12, 7024-7035(15 Dec 1987).

We analyze potential energy surfaces that have been proposed by one of the authors, Bunker, and Chapman and by Raff for the reaction CH_3+H_2bold-arrow-left-rightCH_4+H. The surfaces are modified to remove discontinuities and zero frequencies, where present, and the modified surfaces are compared to each other in terms of reaction-path properties and to ab initio calculations for stationary point properties. They are also used for rate constant calculations which are compared to experiment. The rate constants were calculated by improved canonical variational transition state theory with small-curvature semiclassical adiabatic ground-state transmission coefficients (ICVT/SCSAG) over a wide temperature range, 298—1340 K. Both surfaces yield rate constants in poor agreement with experimental values. The reaction-path analysis leads to a list of potential energy surface features that are important for the rate constants but inaccurate in the existing surfaces and that should be improved in subsequent work.

3837 New potential energy surface for the CH_3 / H_2 bold-arrow-left-right $CH_4 + H$ reaction: Calibration and calculations of rate constants and kinetic isotope effects by variational transition state theory and semiclassical tunneling calculations. Joseph, T.; Steckler, R.; Truhlar, D.G. (Department of Chemistry, University of Minnesota,Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **87**: No. 12, 7036-7049(15 Dec 1987).

We present a sequence of three successively improved new semiempirical potential energy surfaces for the reaction $CH_3 + H_2 \rightarrow CH_4 + H$. The semiempirical calibration is based on ab initio electronic structure calculations and experimental thermochemical data, vibrational frequencies, reaction rate constants, Arrhenius parameters, and kinetic isotope effects (KIE's). To compare to the experimental kinetic data we apply variational transition state theory and semiclassical estimates of tunneling probabilities. We also provide detailed factorization analyses of the KIE's to illustrate the way in which various surface features contribute to the overall KIE's, and we discuss the substantial difficulties in attributing specific kinetic results to isolated potential energy surface features. Each of the three new surfaces, called J1, J2, and J3, has a thinner barrier than the one before. In addition, we provide one example, called surface J2A, showing the effect of making the barrier even thinner than on the best surface. The best surface yields rate constants for the forward and reverse reaction, activation energies, and KIE's that are consistent with most of the available experimental data.

3838 Oxygenated fluorocarbons adsorbed at metal surfaces: chemisorption bond strengths and decomposition. Walczak, M.M.; Leavitt, P.K.; Thiel, P.A. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **109**: No. 19, 5621-5627(16 Sep 1987). Contract W-7405-ENG-82.

The authors report studies of the adsorption bond strengths and decomposition of perfluorodiethyl ether and hexafluoroacetone on clean and oxygen-dosed Ru(001). Perfluorodiethyl ether bonds weakly to Ru(001) (39 kJ/mol) without decomposing. This binding energy is typical for a metal-adsorbate interaction in which the adsorbate donates electrons to the metal from the oxygen lone pair. Hexafluoroacetone bonds to the surface in both a weakly bonded configuration (38 kJ/mol) and a strongly bonded configuration (66-87 kJ/mol), and there is some decomposition. They compare the chemistry of these oxygenated fluorocarbons to analogous oxygenated hydrocarbons. They propose that the net effect of fluorination is to weaken those chemisorption bonds which rely upon electron donation from the oxygen lone pairs to the metal but to strengthen the chemisorption bonds which rely primarily upon electron donation from the metal into antibonding C-O orbitals. Both phenomena can be explained by electronic effects resulting from fluorination.

3839 Equilibria studies involving ligand coordination to open titanocenes: phosphine and pentadienyl cone angle influences and the existence of these electron-deficient molecules. Stahl, L.; Ernst, R.D. (Univ. of Utah, Salt Lake City). *Journal of the American Chemical Society;* **109**: No. 19, 5673-5680(16 Sep 1987).

A series of phosphine adducts of bis(2,4-dimethylpentadienyl)titanium has been prepared, having the formulas $Ti(2,4\text{-}C_7H_{11})_2L$, for which L = $P(C_2H_5)_3$, $P(OC_2H_5)_3$, $P(OC_2H_5)_2H$, $P(OCH_3)_3$, $P(CH_3)_2(C_6H_5)$, and $P(CH_3)_3$. In solution these 16-electron adducts reversibly dissociate the phosphine or phosphite ligands, with respective ΔH values being 10.0, 10.6, 11.4, 12.9, and 14.5 kcal/mol, with the ΔS values falling in the range of 27.4-34.1 eu. Except for the seemingly weak binding by phosphites, these data can be rationalized in terms of reported ligand cone angles, and it is suggested that the cone angles for $P(OMe)_3$ and a few related ligands should be revised, in some cases quite significantly. In addition, the $P(C_2H_5)_3$ adducts of $Ti(3\text{-}C_6H_9)_2$ and $Ti(C_5H_7)_2$ have been prepared (C_6H_9 = methylpentadienyl; C_5H_7 = pentadienyl). Similar studies indicate significantly enhanced phosphine binding, with ΔH and ΔS values being 14.6 kcal/mol and 34.8 eu for the former compound. For the latter complex, no detectable dissociation could be observed up to 60 °C, at which point decomposition took place. This information suggests that nonbonded repulsions between eclipsing pentadienyl methyl groups disfavor the formation of the ligand adducts, and hence they are to a large extent responsible for the isolability of the 14-electron open titanocene, $Ti(2,4\text{-}C_7H_{11})_2$.

3840 $(Me_5C_5)_2Yb(\mu\text{-}Me)Be(C_5Me_5)$: a model for methane coordination?. Burns, C.J.; Andersen, R.A. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 19, 5853-5855(16 Sep 1987). Contract AC03-76SF00098.

One strategy for synthesis of a substituted methane complex, M reverse arrow CH_4X, is to choose a ligand or a group X whose electronegativity is less than that of a methyl group so that the permanent dipole moment is in the direction of carbon rather than X. A convenient molecule is $MeBe(C_5Me_5)$ since it is monomeric, as is $MeBe(C_5H_5)$; therefore, no steric effects will prevent coordination, and it presumably has a dipole moment. A convenient Lewis acid is $(Me_5C_5)_2$ Yb since it is a bent metallocene in gas phase, therefore, the reorganization energy of bending is small, and this 4f metallocene forms coordination complexes with olefins and acteylenes. The geometry of the fragments in the complex in the solid state is very weakly perturbed relative to the individual parts as determined by gas electron diffraction. The principle perturbations are that the Yb-C(C_5Me_5) distance lengthens by ca. 0.06 A and the (Me_5C_5)ring centroid-Yb-(Me_5C_5)ring centroid closes by ca. 13°. In solution the resonance in the ^1H NMR spectrum due to the bridging methyl group is deshielded by 0.1 ppm relative to free $MeBe(C_5Me_5)$. The complex is undergoing rapid intermolecular chemical exchange to -70 °C.

3841 Transition-metal-promoted reactions of boron hydrides. 10. Rhodium-catalyzed syntheses of β-alkenylborazines. Lynch, A.T.; Sneddon, L.G. (Univ. of Pennsylvania, Philadelphia). *Journal of the American Chemical Society;* **109**: No. 19, 5867-5868(16 Sep 1987).

The authors previously shown that transition-metal reagents can be used to activate the B-H bonds in a variety of polyhedral boranes and carboranes and that this activation can induce numerous important synthetic transitions. They have now initiated studies of the application of transition-metal catalysts to promote the reactions of boron nitrogen ring compounds and report here the development of a metal-catalyzed, high yield route of B-alkenylborazines.

3842 Carbon-hydrogen bond activation and carbon-carbon bond formation in the reaction between ethylene and hexaisopropoxyditungsten. Chisholm, M.H.; Hampden-Smith, M. (Indiana Univ., Bloomington). *Journal of the American Chemical Society;* **109**: No. 19, 5871-5872(16 Sep 1987).

Ethylene reacts with certain metal surfaces to give a capping (μ_3) ethylidyne ligand. In triosmium carbonyl chemistry ethylene has been shown to undergo successive C-H activation to give a μ-σ,π-vinyl and a μ-vinylidene ligand. A similar reaction sequence has been reported by Puddephatt and co-workers in the addition of ethyne to a hydrido triangulo platinum complex. The authors have repeatedly emphasized the relationships, both structural and chemical, between reduced metal oxides of molybdenum and tungsten and smaller alkoxide clusters and their larger (closo) counterparts. For example, the square-$Mo_4Cl_4(O\text{-}i\text{-}Pr)_4$ and butterfly-$Mo_4Br_4(O\text{-}i\text{-}Pr)_8$ molecules are arachno subunits of the $M_6(\mu_3\text{-}X)_8$ cluster unit, and $W_4(O\text{-}i\text{-}Pr)_{12}$ represents a fragment of the $M_6(\mu_2\text{-}X)_{12}$ unit. Furthermore the M_4-alkoxide clusters are formed from the coupling of M_2 alkoxides by steric control in the choice of the OR group. Indeed the authors have established that an equilibrium exists between $W_4(O\text{-}i\text{-}Pr)_{12}$ and $W_2(O\text{-}i\text{-}Pr)_6$. One of the authors hypotheses is that these small unsaturated alkoxide cluster units may provide models for active sites on reduced metal oxide surfaces. They describe here the observation of the activation of ethylene by $W_2(O\text{-}i\text{-}Pr)_6$ under extremely mild conditions.

3843 Dynamics of the Wolff Rearrangement: spectroscopic evidence of oxirene intermediate. Tanigaki, K.; Ebbesen, T.W. (NEC Corp., Kawasaki, Japan). *Journal of the American Chemical Society;* **109**: No. 19, 5883-5884(16 Sep 1987).

The Wolff rearrangement, involving the decomposition of an α-diazoketone to yield a ketene, is of great interest and importance in chemistry. Although it has been studied for many years by vari-

ous techniques, the dynamics of this reaction from excitation of a diazoketone to the formation of the final product(s) have eluded direct observation. Only the last intermediate ketene has been observed to react with solvents to yield stable products. Ketene is postulated to be formed from other precursors, ketocarbene and/or oxirene. Ketocarbenes were finally detected by Chapman and his co-workers, very recently, in solid matrices at 15 K by using strained diazoketones. Here the authors report the direct observation of the dynamics of the Wolff rearrangement for an unstrained diazoketone in water at 298 K. The precursor to ketene is observed and assigned to be an oxirine, an important chemical species that had yet be unambiguously detected. Both spectral and dynamic features are presented.

3844 **Control of processibility by particle size in high energy solid propellants.** Curtis, D.D. (to Secretary of the Navy, Washington, DC). US Patent 4,693,764. 15 Sep 1987. Filed date 18 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a solid propellant comprised on a weight basis of about 15.15% hydroxyl terminated polybutadiene polymer combined with isophorone diisocyanate. About 0.05% carbon black and about 84.8% of a mixture of unground HMX has an average means diameter of about 150 microns and ground HMX, has an average mean diameter of about 8 - 16 microns, wherein the ratio of the ground to unground HMX is from 60:40 to 70:30 by weight and wherein the composite HMX particle size distribution is within various limits.

3845 **Critical exponents for the sol-gel transition.** Martin, J.E.; Wilcoxon, J.; Adolf, D. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] A: General Physics;* **36**: No. 4, 1803-1810(15 Aug 1987).

Solutions of tetramethoxysilicon were reacted, using both acid and base as catalysts, until near the sol-gel transition. Portions of the reacting mixture were quenched by dilution, and the average cluster mass and correlation length were measured with use of static and dynamic light scattering. Critical exponents describing the divergences of the average mass and correlation length were found to be larger than the predictions of either the percolation or Flory-Stockmayer theory.

3846 **High oxidation state monopentamethylcyclopentadienyl tungsten methyl complexes including the first d^0 complex containing a highly distorted methylene ligand, W(eta^5-C_5Me_5)$(CH_3)_3(CH_2)$.** Liu, A.H.; Murray, R.C.; Dewan, J.C.; Santarsiero, B.D.; Schrock, R.R. (Massachusetts Institute of Technology, Cambridge). *Journal of the American Chemical Society;* **109**: No. 14, 4282-4291(8 Jul 1987). Contract AC02-78ER04949.

Mono-eta^5-C_5H_5 complexes are among the most common in organometallic chemistry. After pentamethylcyclopentadiene became readily available, many mono-eta^5-C_5Me_5 analogues were prepared and their chemistry compared with that of known eta^5-C_5H_5 complexes. Soon mono-eta^5-C_5Me_5 (Cp*) complexes were discovered that had no eta^5-C_5H_5 analogues, e.g., $TaCp^*(olefin)Cl_2$ and $IrCp^*H_5(SiMe_3)_2$. Such a circumstance appears to be more common when the metal is in a relatively high oxidation state. One of the likely reasons the Cp* ligand apparently stabilizes high oxidation states is its now well-documented ability to donate electron density to the metal. Another important reason is that decomposition pathways involving eta^5-C_5H_5 ring protons are blocked. Relatively recently the authors discovered that $[W(eta^5\text{-}C_5Me_4\text{-}t\text{-}Bu)Cl_4]_2$ was a product of the reaction between the tungstacyclobutadiene complex $W[C(t\text{-}Bu)C(Me)C(Me)]Cl_3$ and 2-butyne. They soon developed a practical route to the eta^5-C_5Me_5 analog and found that WCp^*Me_4 could be prepared readily. They were interested in WCp^*Me_4 first as a means of preparing hydride complexes such as $[WCp^*H_3]_4$ and $[WCp^*H_4]_2$, but then they became interested in exploring its chemistry per se. In this paper they report the first collection of results concerning the chemistry of WCp^*Me_4 and related methyl complexes.

3847 **Coadsorption as a probe of mechanism: cyclic sulfides and straight chain thiols on Mo(110).** Roberts, J.T.; Friend, C.M. (Harvard Univ., Cambridge, MA). *Journal of the American Chemical Society;* **109**: No. 14, 4423-4424(8 Jul 1987). Contract FG02-84ER13289.

The authors reported that tetrahydrothiophene and trimethylene sulfide undergo desulfurization on Mo(110) to form gaseous alkanes and alkenes in a temperature-programmed reaction experiment. In both cases, straight chain alkane evolution preceded alkene evolution. They proposed that the intermediate leading to straight chain alkanes and alkenes from these two cyclic sulfides is a surface thiolate. The thiolate undergoes competitive C_1-hydrogenation to alkane and C_a-dehydrogenation to alkene, depending on the surface hydrogenation concentration. They report here that coadsorbed cyclic sulfides C/sub n/H/sub 2n/S (n = 3, 4) and linear thiols C/sub m/H/sub 2m+1/SH(m = 2, 3, 4) react during a temperature-programmed reaction experiment to form alkanes C/sub n/H/sub 2n+2/ and C/sub m/H/sub 2m+2/ at exactly the same temperature. These experiments lend powerful support to their proposal that cyclic sulfides and straight chain thiols react on Mo(110) by way of a thiolate intermediate.

3848 **Transport and intermolecular interactions in compressed supercritical fluids.** Jonas, J.; Lamb, D.M. (Dept. of Chemistry, School of Chemical Sciences, Univ. of Illinois, Urbana, IL 61801). pp 15-28 of Supercritical fluids: Chemical and engineering principles and applications. Squires, T.G.; Paulaitis, M.E. Washington, DC; American Chemical Society (1987). (CONF-850942—).

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

General overview of several studies of transport and intermolecular interactions in compressed supercritical fluids is presented. The unique aspects of the instrumentation used in these studies are emphasized. First, the results of NMR studies of self-diffusion in supercritical ethylene and toluene are discussed. These experiments used the fixed field gradient NMR spin-echo technique. Second, the novel NMR technique for the determination of solubility of solids in supercritical fluids is described.

3849 **Analysis of lipid classes by HPLC with the evaporative light scattering detector.** Stolyhwo, A.; Martin, M.; Guiochon, G. (Institute of Organic Chemistry, Politechnica Gdanska, Gdansk). *Journal of Liquid Chromatography;* **10**: No. 6, 1237-1254(1987).

The evaporative light scattering detector enables the detection and quantitation of all relatively non-volatile lipids. The mixtures of polar and non-polar lipids were separated in one run, in 20 to 25 minutes on Silica Si-100 columns, using consecutive gradients of pentane to diethylether, to chloroform, to methanol containing a large concentration of ammonia. The flexibility of the method is illustrated by the change in elution patterns following the treatment of the packing material by ammonia. For example, the elution order of phosphatidyl inositol and phosphatidyl choline is reversed and the separation of the former compound from phosphatidyl serine, which is generally difficult, is now accomplished readily.

3850 **Evidence for motional electric field effects in the absorption spectrum of lithium vapor in a magnetic field.** Crosswhite, H.M.; Tomkins, F.S.; Crosswhite, H.; Garton, W.R.S. (Argonne National Lab., IL). pp 707-720 of Photophysics and photochemistry in the vacuum ultraviolet. McGlynn, S.P. (ed.). Amsterdam, Netherlands; D. Reidel Publishing Company (1985). Contract W-31-109-ENG-38.

Some details of the analysis of the diamagnetic spectrum of LiI showing parity mixing arising from a motionally-induced electric field crossed with an applied magnetic field are presented. The author's analysis of a more conventional l- and m-mixing phenomena is discussed. The experimental results are interpreted on the basis of a simple quantum mechanical model given in an (n, l, m/sub l/) basis, which includes paramagnetic and diamagnetic terms, as well as a term representing the induced electric field generated by the component of electronic motion perpendicular to the magnetic axis. 6 references, 9 figures, 2 tables.

3851 **Helium-group gases, compounds.** Stein, L. (Argonne National Lab., IL). pp 586 of Concise encyclopedia of chemical technology. New York, NY; John Wiley & Sons (1985).

The heavy gases, krypton, xenon, and radon, which were long thought to be inert, have now been shown to combine with fluorine and other powerful oxidants to form stable products. Some physical properties of xenon and krypton are tabulated. Radon has been shown to form stable nonvolatile fluorides by heating radon to approximately 400°C with fluorine gas. Radon reacts at room temperature with solid oxidants, such as $O_2^+SbF_6^-$, $O_2^+Sb_2F_{11}$, $N_2F^+SbF_6^-$, and $BrF_2+BiF_6^-$, to form nonvolatile complex salts. The unstable noble gas halides are widely used as light-emitting species in lasers, but stable compounds of the helium-group gases have no industrial uses at present.

4004 Electrochemistry

3852 **(EMR/MSL—MRP/MSL/87/25) Literature survey on the electrodeposition of copper-arsenic alloys.** Morrison, R.M.; MacKinnon, D.J. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Mineral Sciences Lab.). Feb 1987. 33p. (MICROLOG—87-04526). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The presence of arsenic in anode copper can yield better cathode purity during copper electrorefining because of increased slime adherence and can counteract anode passivation effects of other trace elements such as antimony. If insufficient arsenic is present in the metal, copper arsenides potentially may be used as doping agents during anode casting for increasing the arsenic content. Studies dealing with the characterization of copper-arsenic alloys, the electrochemistry of copper and arsenic, and copper arsenide electrodeposition as well as patent disclosures on electrolytic copper arsenide production were surveyed. Based on this literature survey, some relevant work required to determine the application of this methodology to copper electrorefining is suggested. 44 refs., 3 figs., 5 tabs.

4005 Photochemistry

REFER ALSO TO CITATION(S) 3205, 3780, 3862, 3889, 3924, 3926, 3930, 3937, 3939, 3942, 3945, 3950, 3951, 3960, 3977, 3978, 3979, 3980, 3981, 3983, 3986

3853 **(DOE/ER/13235—T2) Photochemical generation of the optoacoustic effect: [Performance report], April 1985-October 1987.** Diebold, G.J. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). Oct 1987. Contract FG02-84ER13235. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001410/JAW.

The theory of the inverse optoacoustic effect for a two-level gas is given. For molecules, a model is constructed based on the harmonic oscillator. Experiments were done on gases (CO, CH_4, SF_6, CO_2, C_3H_8, C_2H_4) to test the temperature dependence of the acoustic signals. The mechanism for sound production in gases at high concentrations is next considered. The range of the theory is extended into the regime where analyte concentrations are high and heat conduction becomes important. Heat conduction effects in optoacoustic spectroscopy are next considered. Sall's equation is solved, and experiments were done. Isotope effects in the H_2-Cl_2 and D_2-Cl_2 reactions were measured using the optoacoustic effect. Results show that the effect permits studies of slight changes in parameters on a time scale fast compared with the reaction. (DLC)

3854 (INIS-mf—11037, pp 23) **Photochemistry with lasers.** Phillips, L.F. (Canterbury Univ., Christchurch, New Zealand. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3855 (INIS-mf—11037, pp 58) **Photochemistry and photophysics of solid polymers.** George, G.A. (Queensland Inst. of Tech., Brisbane, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3856 **(LBL—23944) Theoretical study of indirect photodissociation: Electronic structure and product rovibrational distributions of C_2N_2(C-tilde ^{1}PI/sub u/).** Dateo, C.E. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000466/JAW.

Polyatomic indirect photodissociation is treated as a quantum transition between quasidiscrete and dissociative (photofragment) states within a diabatic representation of the electronic Hamiltonian following a formalism developed by Kresin and Lester (KL). Relative product energy distributions are obtained from the evaluation of a multidimensional Franck-Condon overlap integral. The KL adiabatic method is followed to describe the nuclear dynamics of the dissociative state. The theory is applied to single-photon dissociation of C_2N_2(C-tilde ^{1}PI/sub u/) at 164, 158.7, and 153.6 nm to form CN(X $^2\Sigma^+$) + CN(A ^{2}PI). Ab initio multiconfiguration Hartree-Fock (MCHF) excited state calculations are carried out to provide essential potential energy surface properties for the heavy-particle dynamics treatment. Product vibrational distributions are obtained in a collinear model and theoretical predictions are found to be in good agreement with recent experiments. An extension of the theory to 3-dimensions is described. Product rovibrational distributions and rotational temperatures are reported which take into account bending-vibrational modes and rotations employing only the adiabatic sudden limit of the general formalism of KL. 106 refs., 15 figs., 25 tabs.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 3183, 3941, 3982

3857 **(INIS-mf—11037) 13th AINSE radiation chemistry conference, 12-14 November 1986, Lucas Heights - AINSE Theatre. Conference handbook.** (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1986. 76p. (CONF-8611200—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW.

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

Abstracts of papers are given which cover the fields of radiolysis in aqueous solutions, solids and gases, radiation polymerisation and degradation, excitation in solids and gases, and industrial applications of radiation chemistry.

3858 (INIS-mf—11037, pp 11) **Structure of the hydrated electron.** Robinson, G.W. (Texas Tech Univ., Lubbock, USA). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3859 (INIS-mf—11037, pp 12) **Intra and inter electron transfer with molecules containing metal ions in solution.** Sargeson, A.M. (Australian National Univ., Canberra. Research School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3860 (INIS-mf—11037, pp 13) **Reactions of superoxide anion with some metal complexes of biological interest.** Trotman, S.M.; Webb, J.; Sangster, D.F. (School of Mathematical and Physical Sciences, Murdoch Univ., Western Australia; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3861 (INIS-mf—11037, pp 14) **Oxidation of encapsulated ruthenium complexes.** Bernhard, P.; Sargeson, A.M. (Australian National Univ., Canberra. Research School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3862 (INIS-mf—11037, pp 15) **Radiolysis and photolysis of solid, liquid and gaseous water.** Quickenden, T.I.; Sangster, D.F. (University of Western Australia; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3863 (INIS-mf—11037, pp 16) **Luminescence from pulse irradiated crystalline D/sub 2/O ice.** Quickenden, T.I.; Vernon, C.F.; Sangster, D.F. (University of Western Australia; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3864 (INIS-mf—11037, pp 17) **Effect of crystalline size on the luminescence from pulse irradiated H/sub 2/O ice.** Bakker, M.G.; Quickenden, T.I.; Vernon, C.F.; Freeman, C.G.; Sangster, D.F. (University of Western Australia; Canterbury Univ., Christchurch, New Zealand. Dept. of Chemistry; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3865 (INIS-mf—11037, pp 18) **Studies of the quenching of the luminescences emitted by electron pulse irradiated and UV excited H/sub 2/O ices.** Bakker, M.G.; Green, T.A.; Quickenden, T.I.; Freeman, C.G.; Sangster, D.F. (University of Western Australia; Canterbury Univ., Christchurch, New Zealand. Dept. of Chemistry; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3866 (INIS-mf—11037, pp 20) **Reaction of inert metal (III) complexes with the pure radiolytically generated aquated electron, hydroxyl radical or metal (I) ions.** Lawrance, G.A. (Newcastle Univ., Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3867 (INIS-mf—11037, pp 21) **Primary process in radiation chemistry of condensed phases.** Boas, J.F. (Australian Radiation Lab., Melbourne). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3868 (INIS-mf—11037, pp 22) **Kinetic models for luminescence decay in pulsed electron irradiated calcium oxide crystals.** Boas, J.F.; Cooper, R.; Grant, J.L. (Australian Radiation Lab., Melbourne; Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3869 (INIS-mf—11037, pp 26) **Magnetic resonance studies on radiation induced cross-linking in polymer and model compound.** Sohma, J. (Hokkaido Univ., Sapporo, Japan. Faculty of Engineering). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3870 (INIS-mf—11037, pp 27) **Protective effects in radiation.** Hill, D.J.T. (Queensland Univ., St. Lucia, Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3871 (INIS-mf—11037, pp 28) **Radiolysis of carboxylic acids.** Hill, D.J.T.; O'Donnell, J.H.; Pomery, P.J.; Winzor, C.L. (Queensland Univ., St. Lucia, Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3872 (INIS-mf—11037, pp 29) **/sup 13/C NMR study of radiation induced changes in stereoregularity in polypropylene.** Hanna, J.; Busfield, W.K.; O'Donnell, J.H.; Whittaker, A.K. (Griffith Univ., Brisbane, Australia. School of Science; Queensland Univ., St. Lucia, Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3873 (INIS-mf—11037, pp 30) **Unimolecular and collision-induced fragmentation pathways of polypropylene glycol-1000 adduct ions.** Agma, M.; Derrick, P.J.; Willett, G.D. (New South Wales Univ., Kensington, Australia. School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3874 (INIS-mf—11037, pp 33) **Future development in electron beam curing.** Bett, S. (Polycure Pty. Ltd., Brookvale, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3875 (INIS-mf—11037, pp 37) **Kinetics of the emulsion polymerization of butyl acrylate.** Maxwell, I.A.; Gilbert, R.G.; Napper, D.H. (Sydney Univ., Australia. School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3876 (INIS-mf—11037, pp 43) **Intra and intermolecular electron transfer in cage complexes: a pulse radiolytic study.** Lawrance, G.A.; Miles, E.A.; Sargeson, A.M. (Newcastle Univ., Australia. Dept. of Chemistry; Australian National Univ., Canberra. Research School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3877 (INIS-mf—11037, pp 46) **Electron irradiation of adamantine.** Laurence, G.S.; Sangster, D.F.; Cooper, R.; Campbell-Ling, A. (Adelaide Univ., Australia. Dept. of Physical and Inorganic Chemistry; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics; Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry; San Jose State Univ., CA, USA). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3878 (INIS-mf—11037, pp 47) **Radiation chemistry of copper complexes in non-aqueous solvents.** Laurence, G.S.; Sangster, D.F.; Campbell-Ling, A.; Bond, A. (Adelaide Univ., Australia. Dept. of Physical and Inorganic Chemistry; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics; San Jose State Univ., CA, USA; Deakin Univ., Dept. of Chemistry, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3879 (INIS-mf—11037, pp 48) **Effect of deposition rate and sample thickness on the luminescence from pulse irradiated, polycrystalline, H/sub 2/O ice.** Litjens, R.A.J.; Quickenden, T.I.; Sangster, D.F. (Western Australia Univ., Nedlands; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3880 (INIS-mf—11037, pp 49) **Effect of dopants on the luminescence from pulse irradiated crystalline H/sub 2/O ice.** Bakker, M.G.; Quickenden, T.I.; Trotman, S.M.; Sangster, D.F. (Western Australia Univ., Nedlands; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3881 (INIS-mf—11037, pp 50) **Emission of luminescence from cometary ice and water vapour - some reflections on Halley's comet.** Bakker, M.G.; Quickenden, T.I.; Sangster, D.F. (Western Australia Univ., Nedlands; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3882 (INIS-mf—11037, pp 51) **Fluorescence yield measurements - a valuable addition to kinetic measurements.** Young, J.G.; Cooper, R. (Australian Radiation Lab., Melbourne; Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3883 (INIS-mf—11037, pp 52) **Laser induced fluorescence of radicals used in plasma etching.** Rodrigo, H. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3884 (INIS-mf—11037, pp 53) **Cross-linking mechanism in plasma polymerized methyl methacrylate.** Sohma, J.; Ohno, M.; Ohno, K. (Hokkaido Univ., Sapporo, Japan. Faculty of Engineering). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3885 (INIS-mf—11037, pp 54) **Mechanical property/structure relationships in polyolefins crosslinked by sensitized irradiation.** Appleby, R.W.; Busfield, W.K. (Griffith Univ., Brisbane, Australia. School of Science). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3886 (INIS-mf—11037, pp 55) **Effect of zinc chloride and cadmium iodide on the polymerisation of vinyl pyrrolidone.** Senogles, E. (James Cook Univ. of North Queensland, Townsville, Australia). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3887 (INIS-mf—11037, pp 56) **Further directions in the use of radiation in the study of the mechanism of free radical latex polymerization.** McKinnon, I.R.; Wilson, I.R.; Coller, B.A.W. (Monash Univ., Clayton, Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3888 (INIS-mf—11037, pp 57) **Determination of diffusion controlled termination rate coefficients.** Adams, M.E.; Napper, D.H.; Gilbert, R.G.; Sangster, D.F. (Sydney Univ., Australia. School of Chemistry; Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3889 (INIS-mf—11037, pp 59) **Some reactive intermediates formed by thermal, photochemical and radiolytic processes.** Wentrup, C. (Queensland Univ., St. Lucia, Australia. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3890 (INIS-mf—11037, pp 63) **Free radical reactions with colloidal metal oxides.** Mulvaney, P.; Denison, L.; Grieser, F.; Cooper, R.; Meisel, D. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry; Argonne National Lab., IL, USA). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3891 (INIS-mf—11037, pp 64) **Current ideas and developments in radiation chemistry.** Cooper, R. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3892 (INIS-mf—11037, pp 65) **Radiation techniques in the study of emulsion polymerisation.** Napper, D. (Sydney Univ., Australia. School of Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

3893 **(RISO-M—2621) Radiolysis of aqueous solutions of ammonium bicarbonate over a large dose range.** Draganic, Z.D.; Draganic, I.G.; Negron-Mendoza, A.; Navarro-Gonzales, R.; Albarran-Sanchez, M.G.; Sehested, K. (Risoe National Lab., Roskilde (Denmark)). Dec 1986. 16p. Risoe Library, DK-4000 Roskilde, Denmark.

0/sub 2/-free aqueous solutions of 0.05 mol dm /sup -3/ ammonium bicarbonate were studied after receiving various doses of / sup 60/Co gammas (0.001-170 Mrd) or krd pulses of 10 MeV electrons. Formate, oxalate, formaldehyde and an unidentified polymer (M/sub w/14000-16000 daltons) were found to be the main radiolytic products. A large inital yield of formate in the γ-radiolysis, G(HCOO/sup -/) = 2.2, is due to the reaction CO/sub 2//sup -/ + HCO/sub 3//sup -/ reversible HC00/sup -/ + CO/sub 3//sup -/. The efficiency of organic synthesis within the large dose range studied is low and is explained by efficient pathways to the reformation of bicarbonate, where the reaction CO/sub 2//sup -/ + CO/sub 3//sup -/ is particularly significant. Computer fitting of the data obtained in the γ-radiolysis and by pulsed electron beam experiments gives k(CO/sub 2//sup -/ + HCO/sub 3//sup -/) = (2 +- 0.4) x 10/sup 3/ dm/sup 3/mol/sup -1/s/sup -1/, k(CO/sub 2//sup -/+ CO/sub 3//sup -/) = (5 +- 1) x 10/sup 7/ dm/sup 3/mol/sup -1/s/sup -1/, k(NH/sub 2/ + = HCO/sub 3//sup -/) < 10/sup 4/ dm/sup 3/mol/sup -1/s/sup -1/ and k(NH/sub 2/ + CO/sub 3//sup -/) = (1.5 +- 0.5) x 10/sup 9/ dm/sup 3/mol/sup -1/s/sup -1/. 18 refs.

3894 **(RISO-M—2621) Radiolysis of aqueous solutions of ammonium bicarbonate over a large dose range.** Draganic, Z.D.; Draganic, I.G.; Negron-Mendoza, A.; Navarro-Gonzales, R.; Albarran-Sanchez, M.G.; Sehested, K. (Risoe National Lab., Roskilde (Denmark)). Dec 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753363/JAW.

0/sub 2/-free aqueous solutions of 0.05 mol dm /sup -3/ ammonium bicarbonate were studied after receiving various doses of / sup 60/Co gammas (0.001-170 Mrd) or krd pulses of 10 MeV electrons. Formate, oxalate, formaldehyde and an unidentified polymer (M/sub w/14000-16000 daltons) were found to be the main radiolytic products. A large initial yield of formate in the γ-radiolysis, G(HCOO/sup -/) = 2.2, is due to the reaction CO/sub 2//sup -/ + HCO/sub 3//sup -/ reversible HC00/sup -/ + CO/sub 3//sup -/. The efficiency of organic synthesis within the large dose range studied is low and is explained by efficient pathways to the reformation of bicarbonate, where the reaction CO/sub 2//sup -/ + CO/sub 3//sup -/ is particurlarly significant. Computer fitting of the data obtained in the γ-radiolysis and by pulsed electron beam experiments gives k(CO/sub 2//sup -/ + HCO/sub 3//sup -/) = (2 +- 0.4) x 10/sup 3/ dm/sup 3/mol/sup -1/s/sup -1/, k(CO/sub 2//sup -/+ CO/sub 3//sup -/) = (5 +- 1) x 10/sup 7/ dm/sup 3/mol/sup -1/s/sup -1/, k(NH/sub 2/ + = HCO/sub 3//sup -/) < 10/sup 4/ dm/sup 3/mol/sup -1/s/sup -1/ and k(NH/sub 2/ + CO/sub 3//sup -/) = (1.5 +- 0.5) x 10/sup 9/ dm/sup 3/mol/sup -1/s/sup -1/. 18 refs.

3895 **Multichannel interactions in the resonant photoionization of HCl.** White, M.G.; Leroi, G.E.; Ho, M.; Poliakoff, E.D. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* 87: No. 11, 6553-6558(1 Dec 1987). Contract AC02-76CH00016.

Vibrational state distributions of the A $^2\Sigma^+$ excited state of HCl^+ were measured by dispersed fluorescence following resonant photoionization. Autoionization of levels excited at the NeI resonance line strongly influence the vibrational branching ratios of the A $^2\Sigma^+$ state although not in accord with the propensity rule expected for vibrational autoionization. Other measurements utilizing total fluorescence yields and synchrotron radiation confirm the presence of competing dissociation channels for autoionizing Rydberg states converging to the A $^2\Sigma^+$ limit. These results are discussed in terms of the multichannel interactions responsible for determining the observed ion and fragment product distributions.

3896 **Excess electrons in simple fluids. IV. Real time behavior.** Nichols A.L. III; Chandler, D. (Department of Chemistry, University of California, Berkeley, California 94720 and Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics;* 87: No. 11, 6671-6681(1 Dec 1987).

The polaron theory for an excess electron in liquids due to Chandler et al. [J. Chem. Phys. 81, 1975 (1984)] is extended to the real time domain by the method of analytic continuation. For the case of an adiabatic solvent, the theory predicts that the electron momentum correlations relax nonexponentially in time, and that this long time tail contributes to a diminuation of the electron mobility. However, for short ranged forces, a mean-field approximation employed in this application of the polaron theory leads to a decay that is one power of t^{-1} higher than the generally accepted result for the quantum Lorenz gas. Along with this analytical analysis, we present numerical solutions of the analytically continued equations for the case of an adiabatic hard sphere solvent. We find that at low solvent densities, the electronic states are relatively diffuse, and the absorption spectra is maximum at the zero frequency diffusive mode. In this density regime, the electron mobility is a decreasing function of temperature. At higher densities, the electron mobility drops precipitously and the spectra has its maxima at a nonzero frequency. Here, the mobility is an increasing function of temperature. Corresponding behaviors of the electron mean-square displacement correlation function are discussed. The high density behaviors are the dynamical consequences of ground state dominance or self-trapping where diffusion requires excitation to high energy extended states. These results augment our earlier work on the equilibrium or thermodynamic consequences of this theory.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 3142, 3813, 3889, 4447, 4448, 4468, 4494

3897 **(CRN-DCPR—86-01) Insight on radiochemestry in France at IN2P3.** Guillaumont, R.; Adloff, J.P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 26p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750242/JAW.

This paper gives a definition of radiochemistry after recalling briefly some historical aspects. Then, one presents the field of activities of radiochemistry, the international context of radiochemistry and the present French research work in radiochemistry. Finally, the radiochemistry prospects are evoked with the education possibilities which are presently offered.

3898 **(INIS-mf—10722) Study of the transport characteristics of uranyl chloride in a highly concentrated aqueous solution of sodium chloride.** Murso, H. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Chemie). 27 Mar 1986. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750025/JAW.

The purpose of this work was the study of the transport processes of uranyl chloride at various temperatures, in order to be able to estimate the danger potential of the intrusion of water during storage in salt form. For this the concentration dependency of the approximated principal diffusion coefficients of uranyl chloride in a table salt solution, which with a c(NaCl) = 5.2 mol/l is almost at the saturation point, was studied at 25, 40 and 50degC. The measurements were successful in the ternarian system UO/sub 2/Cl/sub 2/-NaCl-H/sub 2/O with absorption optics. An unexpected temperature dependency of the diffusion coefficients was found, which reached its minimum at 40degC with UO/sub 2/Cl/sub 2/ concentrations of less than 2x10/sup -2/ mol/l. For comparison the diffusion coefficients were measured in the binary system UO/sub 2/Cl/sub 2/-H/sub 2/O and compared with theoretical calculations. The cause for the poor correlation found here is thought to be the hydrolysis products, whose formation is strongly influenced by the foreign-electrolyte concentration (NaCl). For clarification, viscosity measurements and molar mass determinations (ultracentrifuge) will be done. Some pH-dependent hydrolysis equilibriums are being postulated and the equilibrium constants of uranyl hydroxo complexes are being determined by sedimentation analysis.

3899 (INIS-mf—11046, pp 62) **Determination of the effectiveness of labelling of a new Tc-99m blood platelet labelling set.** Labuschagne, J.P.L.; Van Aswegen, A.; Loetter, M.G.; Minnaar, P.C.; Van Wyk, A.J. (University of the Orange Free State, Bloemfontein, South Africa. Dept. of Biophysics; Atomic Energy Corp. of South Africa, Pty Ltd., Pretoria). 1987. (In Afrikaans). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

3900 **(Juel—2122) Nearly carrier-free /sup 18/F-fluorine alkylation and /sup 18/F-fluorine acylation.** Block, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie 1 -Nuklearchemie; Koeln Univ. (Germany, F.R.)). Mar 1987. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750186/JAW.

Preparation and introduction of n.c.a. [/sup 18/F]-fluoroalkyl and n.c.a. [/sup 18/F]-fluoroacyl moieties as small prosthetic groups were studied as alternatives to n.c.a. labeling via direct nucleophilic substitution. Starting materials for the n.c.a. [/sup 18/F]-fluoroalkylation were symmetrical disubstituted alkanes and α-substituted carboxylic acid esters for the n.c.a. [/sup 18/F]-fluoroacylation. The nucleophilic fluorination of these precursors were systematically investigated with regard to the effect of various important reaction parameters. The monofluorinated prosthetic groups, both monofluorinated alkanes and α-fluorinated carboxylic acid esters, were obtained under optimized conditions with radiochemical yields of about 90% using the efficient fluorination system aminopolyether 2.2.2./potassium carbonate in acetonitrile as solvent. The n.c.a. [/sup 18/F]-fluoroalkylation of protic functional groups via condensation were performed as a one pot synthesis under basic conditions. The radiochemical yields of these condensation reactions depended on the acid constant of the organic substrates. The highest yields of about 90% of fluoroalkylated products were achieved in acetonitrile with phenols as substrates and n.c.a. [/sup 18/F]-fluorotosyloxyalkanes as the most valuable fluoroalkylating agents. The n.c.a. [/sup 18/F]-fluoroacylation of -OH and -NHR functional groups were carried out in two steps. The highest yields of about 85% of fluoroacylated products were obtained in the presence of acids in polar protic solvents when simple primary amines were used as substrates and α-fluoropropionic acid methylester as the best n.c.a. [/sup 18/F]-fluoroacylating agent. The [/sup 18/F]-fluoroalkylation via bistosyloxyalkanes was applied to the synthesis of n.c.a. [/sup 18/F]-fluoroalkylspiperones, potent dopamine receptor ligands to be used for receptor mapping in conjunction with positron emission tomography.

3901 (NEI-DK—39, pp 99) **Problems of quality assurance on accelerator-produced generator systems for the continuous infusion of short-lived radionuclides.** Watson, I.A.; Waters, S.L. (MRC Cyclotron Unit, Hammersmith Hospital, London, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3902 (NEI-DK—39, pp 98) **Quality control of iodothyrosines and iodothyronines with HPLC.** Booc, A.; Devenyi, N. (Institute of Isotopes of the Hungarian Academy of Sciences, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3903 (NEI-DK—39, pp 97) **New methods for the simultaneous determination of I-131 hippuran and its expected main contaminant after previous separation.** Rakias, F.; Toeroek, I.; Kelemen-Kuettel, I.; Paal, T.L. (National Institute of Pharmacy, Budapest, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3904 (NEI-DK—39, pp 96) **"One-chromatogram" determination of Tc-99M Cretec /sup (/R)/sup /purity.** Funch-Rosenberg, H. (Rigshospitalet, Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3905 (NEI-DK—39, pp 94-95) **Quality control of molybdenum 99-technetium 99m generators prepared with fission product molybdenum.** Rotta, M.C.; Viirsoo, M. (Comision Nacional de Energia Atomica Buenos Aires, AR). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3906 (NEI-DK—39, pp 91) **Control of radiopharmaceuticals by gel-filtration in the presence of serum.** Sestakov, G. (Institut za Patofiziologija i Nuklearna Medicina, Medicinski Fakultet, Skopje, YU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3907 (NEI-DK—39, pp 83) **Protein binding of Tc-99m agents for kidney studies.** Patricio, L.; Gano, M.L.; Castanheira, I. (Instituto de Energia, Laboratorio Nacional de Engenharia e Tecnologia Industrial, PT). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3908 (NEI-DK—39, pp 65-66) **Method for separating sucrose octasulfate from sucralfate.** Liberatore, M.; Clemente, M.; Signori, C.; Di Rocco, E.; Delfini, M.; Scopinaro, F. (University "La Sapienza", Roma, IT). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3909 (NEI-DK—39, pp 17-18) **Labelling methods with Tc-99m.** Sundrehagen, E. (Oslo, NO). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3910 (NEI-DK—39, pp 16) **Labelling methods with indium radionuclides.** Mather, S.J. (London, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3911 (NEI-DK—39, pp 14-15) **Labelling methods with radioactive iodine.** Bremer, K-H.; Schwarz, A. (Frankfurt, DE). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3912 (NEI-DK—39, pp 8-9) **Design and development of radiopharmaceuticals based on monoclonal antibodies.** Saccavini, J.C.; Kremer, M. May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3913 (NEI-DK—39, pp 92-93) **Quality of Tc-99m eluates.** Vucina, J.V.; Milenkovic, S.M.; Karanfilov, E.S.; Vuga, D.A. (The Boris Kidric Institute of Nuclear Science, Vinca, YU; The Institute for Radioisotopes, Beograd, YU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

3914 (PTB-SE—14, pp 15-26) **Dissolution of AgI, NpO/sub 2/, and TcO/sub 2/ in water and salt liquor under aerobic and anaerobic conditions.** Lieser, K.H.; Coetzee, P.P.; Foerster, M.; Hanke, C.; Jaehrling, B.; Muehlenweg, U.; Sipos-Galiba, I. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Solubility of AgI in water is low, but is better in NaCl solutions due to complex formation. Radiolysis of AgI leads to iodine release. The dissolution of NpO/sub 2/ proceeds via oxidation to Np(V) and strongly depends on the history of the NpO/sub 2/. The dissolution process and the impact of the radiolysis are discussed. The dissolution of TcO/sub 2/ also proceeds via oxidation. The process velocity likewise depends on the pre-treatment and the oxygen concentration in the solution, and on the specific surface. Dissolution with complex formation is not found in neutral NaCl solutions.

3915 (PTB-SE—14, pp 27) **Interaction between neptunium and NaCl solution.** Kanellakopulos, B.; Apostolidis, C.; Kim, J.I. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie; Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

3916 (PTB-SE—14, pp 41) **Americium solubility in carbonate media.** Vitorge, P.; Robouch, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92, France). Oct 1986. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

3917 (PTB-SE—14, pp 42-52) **Study of interactions between lanthanides/actinides and humic substances by a steric exclusion chromatographic method.** Moulin, V. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92, France). Oct 1986. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The knowledge of cation-humic matter interactions has a great importance in order to have a better understanding of the contribution of these substances to the possible transport of radioactive elements in the geosphere via groundwaters. The method chosen to study the formation of soluble species between lanthanides/actinides ions and humic acids from different origins is a chromatographic technique of gel filtration. This dynamic equilibrium method is based on the separation of the formed complex and the free cation by the porous packing gel. Different elements have been studied by this method: UO/sub 2//sup 2+/, Eu/sup 3+/, Th/sup 4+/ and global interaction constants have been calculated. The application to transuranic elements is undertaken.

3918 (PTB-SE—14, pp 64-76) **Radiolytic effects on the redox behaviour of Np, Pu and Am in concentrated salt solutions.** Lierse, C.; Bueppelmann, K.; Magirius, S.; Kim, J.I. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

In the course of solubility studies with Am(III) and Pu(IV) hydroxide in the presence of high chloride concentrations, a radiolytically induced oxidation of Am(V) and Pu(VI) has been observed by spectrophotometrical measurements. This oxidation process has been seen to be dependent on the specific α-activity in the solution, as well as on the pH-value and the chloride concentration. During the experiments, a considerable increase in the redox potential to values of over +1000 mV could be measured. The results are interpreted to reveal a radiolytic formation of oxidizing chlorine species, and their reaction with the actinide ions present in the solution. A reaction pattern is presented for the radiolysis of concentrated chloride solutions which describes all the phenomena observed. This pattern and the Eh-pH-diagrams of Np, Pu and Am are used as a basis for discussing the redox behaviour of actinides in salt solution.

3919 (PTB-SE—14, pp 184-195) **Extrapolation of radioiodine sorption data obtained by laboratory experiments to in-situ conditions.** Behrens, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Radiohydrometrie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

In order to investigate the behaviour of iodine in geological aquifer systems, tracer-iodine sorption experiments have been made in a laboratory system with soil and rock samples from the natural environment, using iodide as a representative form of the iodine. In experiments with surface waters or near-surface waters, transformation reactions of the iodide are observed, resulting in strong adsorption of the radioiodine. This effect is attributed to microbial activities. Applying the laboratory data to the sorption of radioiodine on material from the Gorleben aquifers has shown that microbiology is

a parameter of great significance and therefore has to be included in all studies for migration modelling of radionuclides.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 2910

3920 (BNL—52069, pp 1-6) **Aromatics oxidation and soot formation in flame.** Howard, J.B.; McKinnon, J.T. (Massachusetts Institute of Technology, Cambridge). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Kinetics and mechanisms of aromatics oxidation and soot formation in flames are being studied by measuring profiles of soot particle size and number concentration, stable and radical gaseous species concentrations, and temperature in premixed flat flames at 2.67 kPa. Net reaction rates calculated from these measurements are used to test mechanism of soot formation and oxidation of aromatic species. Two complimentary methods will be employed to measure soot sizes and concentrations. The primary technique will be optical scattering and extinction using an argon-ion laser. Scattering measurements will be performed using the 488 nm line of the laser. For the extinction measurements, they will use the 1.09 micron line. At this region of the infra-red they can be reasonably confident that only soot species, and no PAH, will absorb. Extinction measurements will also be made in the visible range, as an indication of the amount of PAH present. To back up the optical methods, especially in the nucleation zone of the flame, samples of soot will be withdrawn from the flame using a molecular beam system. Analysis of these samples will be performed with transmission electron microscopy. Major gas species and PAH will be sampled with uncooled quartz microprobes. PAH samples will be collected in two cryogenic traps, extracted with methylene chloride, and analyzed using high pressure liquid chromatography or gel permeation chromatography. The samples will be resolved into broad ranges of molecular weights, rather than identifying every species. The dynamics of these classes, together with the soot growth kinetics, will help in modeling nucleation processes. The major gas species will be analyzed using gas chromatography.

3921 (BNL—52069, pp 7-9) **Shock tube studies of the pyrolyses of compounds pertinent to the pre-particle soot formation process.** Kern, R.D.; Pamidimukkala, K.M.; Wu, C.H.; Yong, J.N.; Duplantier, A.J. (Univ. of New Orleans, LA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Acetylene is a major product in the pyrolyses of aromatic hydrocarbons and other soot producing fuels such as allene and butadiene. It is important to establish a mechanism for C_2H_2 decomposition in order that it may be employed reliably as a subset in the more complex mechanisms necessary to describe the kinetics of toluene, benzene, ethylbenzene, allene, 1,2 and 1,3 butadiene. They have constructed a 37 step mechanism which accounts for the reaction profiles obtained for C_2H_2, C_4H_2 and C_6H_2 by sampling reflected shock zone gas via time-of-flight mass spectrometry (TOF). Building upon the foundation established by Gardiner and Kiefer, they were able to fit the TOF data, single pulse shock tube (SPST) results and atomic resonance absorption (ARAS) experiments over a wide range of temperatures and pressures. The goodness of the TOF fit was assessed by a pM analysis. Calculation of sensitivity coefficients showed clearly the competition between two possible dissociation channels and their dependence upon C_2H_2 concentration. The relatively low computed yields for C_6H_2, C_4H_2 and C_6H_6 were consistent with the TOF experimental conditions. This work supports the contention that the polyacetylenic sequence of reactions is not an efficient pathway to soot formation.

3922 (BNL—52069, pp 10-14) **Soot production in axisymmetric laminar diffusion flames at pressures from one to ten atmospheres.** Flower, W.L.; Bowman, C.T. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

In previous studies of soot production in diffusion flames at elevated pressure, global measurements of soot yield (soot mass/fuel-carbon mass) were found to increase significantly with pressure. A common feature of the early studies of pressure effects on soot formation in diffusion flames is the measurement only of total soot yield or other global parameters, which are influenced both by soot formation and by soot oxidation. While measurements reported in their own previous work did provide spatial resolution, only the soot-formation region was studied. Hence, from previously available data it was not possible to determine the relative importance of formation and oxidation processes in the overall production of soot in high-pressure diffusion flames or to explain the observed dependence of soot yield on pressure. The objective of a series of experiments conducted this year was to investigate soot formation and oxidation processes in axisymmetric laminar ethylene/air diffusion flames at pressures from 0.1-1.0 MPa. These experiments provide insight into the pressure dependence of phenomena which control soot emissions from diffusion flames at elevated pressure. The apparatus used in this study consists of a 1.27-cm-diameter vertical circular burner tube that is surrounded by a co-flowing air stream and is enclosed in a pressure vessel of rectangular cross section. Measurements of the attenuation of laser light across the flame diameter were used to characterize the volume of soot present in the flame. It may be shown that the logarithm of the transmitted laser intensity is proportional to the integral of the soot volume fraction across the flame diameter. Data were acquired as a function of axial position above the burner port, allowing independent identification and examination of regions of soot formation and soot oxidation.

3923 (BNL—52069, pp 15-18) **Shock tube studies of high temperature hydrocarbon pyrolysis rates.** Kiefer, J.H. (Univ. of Illinois, Chicago). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This past year they have continued the study of hydrocarbon pyrolysis kinetics using both laser schlieren and flash absorption techniques. The author has also spent the period September 15, 1985 to March 15, 1986 at Argonne National Lab constructing a new, high purity shock tube and ancilliary apparatus for flash absorption measurements in the vuv.

3924 (BNL—52069, pp 19-22) **Combustion kinetics and reaction mechanisms.** Klemm, R.B.; Michael, J.V.; Sutherland, J.W. 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The main objective of this project is to determine absolute rate constants for combustion-related reactions. An ancillary goal involves the investigation of the mechanistic factors in gas phase combustion and pollutant-formation processes. Progress is reported in several phases of this project with details given under separate headings.

3925 (BNL—52069, pp 23-30) **Theoretical studies of chemical reactions.** Wagner, A.F.; Davis, M.J.; Harding, L.B.; Bair, R.A.; Shepard, R.; Dunning, T.H. Jr. (Argonne National Lab., IL). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Theoretical calculations are presented for chemical reactions of interest. Improved statistical theories are presented to more accurately represent in phase space the unimolecular dissociations and reactions based on bottlenecks. Specific information is presented for the reaction of oxygen with acetylene the reactions of the hydro-

gen atom with the peroxyl radical, and the reactions of the methylidyne radical with molecular nitrogen.

3926 (BNL—52069, pp 31-35) **HTP kinetic measurements on isolated elementary combustion reactions over wide temperature ranges. The O (^{3}P) + C_2H_4 reaction.** Fontijn, A.; Mahmud, K. (Rensselaer Polytechnic Institute, Troy, NY). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Kinetic data on single elementary reactions covering wide temperature ranges and obtained in one apparatus are rare. Yet, such data are much needed to help arrive at a reliable experimental data base for use by combustion modellers and theoretical kineticists. It is the goal of this work to provide this type of information in the 300-1800 K temperature range for bimolecular elementary reactions, occurring in the combustion of fossil fuels. The pseudostatic HTP (high-temperature photochemistry) technique developed for this purpose is used. It is an adaptation of the flash-photolysis resonance-fluorescence method commonly used nearer room temperature. The use of different construction materials has allowed the increased temperature range. No other direct measurements of the rate coefficients for this reaction in the 1050-1600 K range exist. They have concentrated on this temperature regime, but also have included measurements from 300-1000 K to check the agreement with earlier work.

3927 (BNL—52069, pp 36-40) **Kinetics of the reaction of NCO with ethene and oxygen over the temperature range 295-662 K.** Perry, R.A. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The NCO radical is intimately connected with nitric oxide formation from fuel-bound nitrogen in combustion systems. In order to model nitrogen chemistry in combustion systems, it is essential to explore the possible chemical reactions that might enter into any extensive model of nitrogen chemistry in these systems. Laser photolysis/laser-induced fluorescence was used to create and monitor the NCO radical on a millisecond time scale. The experimental technique has been discussed in detail previously and will not be repeated here. In all experiments, exponential decays of the NCO fluoreacence signals were observed. The data were analyzed by numerical least squares fitting of the decays. The measured decay rates were found to depend linearly on the concentration of added reactant for fixed total pressure and temperature. The absolute rate constants were determined by plotting the measured decay rate against reactant concentration and performing a least squares fit to obtain the slope, K/sub i/. Rate constants, k_1, for the reaction of NCO with ethene were determined over the temperature of 295-652 K with the total pressure being varied from 10-372 Torr at 295 K. The Arrhenius expression describing the region from 295-447 K is $k_1 = 3.0 \times 10^{-13}$e/sup (230 +/- 300)/RT/ cm^3 molecule^{-1} s^{-1}, where the error limit in the activation energy is the estimated overall error limit.

3928 (BNL—52069, pp 41-46) **Theoretical prediction of kinetic rate coefficients in combustion.** Miller, J.A.; Melius, C.F.; Brown, N.J. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The emphasis in this work is on the prediction of rate coefficients and branching ratios for chemical reactions that occur over one or more potential wells. Such reactions are complicated by a number of factors. One factor is that the complex formed initially from the reactants may isomerize any number of times and each isomer may dissociate into several different product channels. In the first two projects discussed here, they use the strong-coupling (or RRKM) approximation to treat two such reactions important in the nitrogen chemistry of flames. In the third project, they use quasi-classical trajectory methods to elucidate the apparent violation of the strong-coupling approximation in the reaction O + OH → O_2 + H. This latter reaction, viewed from the reverse direction, is the single most important reaction in combustion.

3929 (BNL—52069, pp 47-52) **Modeling chemical kinetics of combustion.** Westbrook, C.K. (Lawrence Livermore National Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The primary goal of the program at LLNL is to identify the key reaction steps in the oxidation of hydrocarbon fuels, and to use the resulting chemical kinetic reaction mechanisms to study various experimental and applied combustion problems. Some of the physical systems which have been examined recently at LLNL using these kinetic models include laminar flames, shock waves and detonations, reactive flow systems such as static and continuously stirred tank reactors, pulse combustors, and internal combustion engines. Efforts during the past year have been concentrated in two major areas. The first project area consists of extending existing kinetic reaction mechanisms to treat larger fuels. Following recent studies of propane and propene and n-butane, these models have been extended to describe oxidation of n-pentane and iso-butane. Further development has pushed the same type of analysis to describe oxidation of n-octane and iso-octane in laminar flames and the turbulent flow reactor. The primary interest of the present modeling program is the development of an understanding, in fundamental kinetic terms, of the role that the structure of the fuel molecule plays in determining its combustion properties. It is well established that straight chain hydrocarbon fuels ignite more rapidly and have lower octane numbers and lower sooting tendencies than do branched chain fuel molecules.

3930 (BNL—52069, pp 53-57) **Theoretical combustion and ignition chemistry.** Brown, N.J. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Ignition by excimer laser photolysis of ozone was investigated. Mixtures of hydrogen, oxygen, and ozone were ignited in closed cells with 248 nm radiation from a KrF excimer laser. Ozone, the only significantly absorber in this system, is photolyzed and produces oxygen atoms which initiate combustion. A discretized, time-dependent Beer's Law model is used to demonstrate that the radical concentration immediately after photolysis is a function of laser power, ozone concentration, focal length, and separation between the lens and reaction cell. Spark schlieren photographs are used to visualize the ignition events and identify ignition sites, and these are compared with calculated radical concentration profiles to show that the absorption is a single photon process. Combustion was also confirmed by observing the temporal pressure profile recorded during each experiment with a Kistler 211B piezotron flush mounted in the cell wall. The effects of equivalence ratio, pressure, and the initial gas temperature on the minimum ozone concentration needed to produce ignition were determined, and initial gas temperature was the only one of these which had a significant effect. Modeling studies of ignition were performed to aid in the interpretation of the experimental results, and these confirmed that ignition is not due solely to thermal effects, but is strongly dependent on the number and type of radicals present initially after photolysis. Ignition using other hydrocarbons as fuels was also investigated.

3931 (BNL—52069, pp 58-62) **Comprehensive mechanisms for combustion chemistry: an experimental and numerical study with emphasis on applied sensitivity analysis.** Dryer, F.L. (Princeton Univ., NJ). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This research program is the continuation of an integrated effort for determining the reaction mechanisms responsible for the oxidation of hydrocarbon structures under conditions representative of combustion environments. Recent efforts have continued to demonstrate the use of experimental studies combined with gradient

sensitivity analysis to elucidate the behavior of coupled elementary kinetic reactions. In particular, the elementary kinetic systems studied have been the effects of addition of small amounts of hydrocarbons to the $CO/H_2O/O_2$ system, the formaldehyde pyrolysis and oxidation, and the oxidation chemistry of simple alcohols. The accomplishments in each of these areas are briefly described.

3932 (BNL—52069, pp 63-64) **Fast flow studies of CH kinetics.** Anderson, S.M.; Freedman, A.; Kolb, C.E. (Aerodyne Research, Inc., Billerica, MA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The CH radical plays an important role in combustion systems, affecting both kinetics and pollutant production. Thus far, nearly all direct studies of CH reactions have been performed using laser flash-photolysis techniques over a moderate temperature range (< 700 K). A recent in-situ study of OH and CH kinetics in a flame concluded that high temperature rate coefficients for CH reactions are needed. They have developed a chemical source of CH radicals suitable for fast flow kinetic and product channel studies. In combination with the high temperature flow reactor available in their laboratory, this source permits study of CH reactions with a wider variety of molecules and over a greater temperature range (300-1300K) than is possible in flash photolysis systems. CH radicals are produced by sequential halogen atom abstractions from CHBr by atomic sodium in a source reactor separated from the main reactor tube. The efficiency of $CHBr_3$ to CH conversion is about 10%, and an analysis of the source kinetics is presented. They are presently using this source to measure reaction rate coefficients for CH + O_2, C ell_3, N_2O and NO. These results are presented and compared with those available in the literature. The results are discussed in terms of CH/oxidant reaction mechanisms.

3933 (BNL—52069, pp 65-68) **Kinetics and mechanisms of key elementary processes of importance to high temperature combustion chemistry.** Lin, M.C.; Sanders, W.A.; Lin, C.Y.; Umstead, M.E. (Catholic Univ. of America, Washington, DC). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The purpose of this project is to study the kinetics and mechanisms of key elementary chemical processes relevant to high temperature combustion. Major emphasis is placed on reactions involved in the combustion of benzene and related chemical species. Shock-tube studies of high-temperature processes are combined with computer modeling of complex reaction mechanisms and extrapolation of low-temperature rate constants by the TST-RRKM theory.

3934 (BNL—52069, pp 73-76) **Theoretical studies of combustion dynamics.** Bowman, J.M. (Illinois Institute of Technology, Chicago). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The reactions of $O(^3P)+H_2$, D_2, and HD are the focus of this research. Their approximate three-dimensional quantum calculations of the rate constant for both the ground and first excited vibrational states of the above reactions were completed last year. Comparisons of the calculated rate constants, isotope effects and branching ratios have been made with available experimental work and also with the variational transition state theory calculations. The main conclusion of that paper is that tunneling plays a major role in the reaction dynamics at room temperature and below.

3935 (BNL—52069, pp 77-81) **Unimolecular reaction dynamics and vibrational overtone spectroscopy of highly vibrationally excited molecules.** Crim, F.F. (Univ. of Wisconsin, Madison). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The authors studies combine a selective excitation technique with spectroscopic detection to provide new experimental data on the dynamics of highly vibrationally excited molecules. In these experiments, direct excitation of overtone vibrations prepares highly excited molecules and time-resolved spectroscopy monitors the reaction products, often at the level of individual quantum states. Most recently they have used this approach to study a complex molecule, tetramethyldioxetane, in new detail by reducing its internal energy in a free jet expansion and to obtain highly resolved vibrational overtone spectroscopic data on a prototypical small molecule, hydrogen peroxide. The goal in all of this work is to remove the averaging over initial states that is inherent in many studies of highly vibrationally excited molecules in order to make a detailed comparison with theoretical descriptions of unimolecular reaction dynamics.

3936 (BNL—52069, pp 82-88) **Measurement of rotational energy transfer rates for HD (v = 1) in collisions with thermal HD.** Chandler, D.W.; Farrow, R.L. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

At low collision energies the dominant energy transfer process is the exchange of energy between the rotational and translational degrees of freedom. Despite this there are few direct studies of this process for ground-electronic-state species. They report state-to-state rotational energy transfer rates for HD excited to the first excited vibrational level of the ground electronic state. Stimulated Raman scattering is used to produce the rotationally selected, vibrationally excited HD. Subsequent collisional energy transfer from the prepared state, upon collision with a thermal distribution of HD, is monitored by multiphoton ionization through the E,F electronic state. The data are analyzed by solving the rate equations coupling the lowest six rotational states of the first excited vibrational level. In this manner, both the absolute rate constants and the optimum shape of the energy transfer probability density function are determined. Several forms of an exponential energy gap scaling law are used to parameterize their results.

3937 (BNL—52069, pp 89-95) **Molecular beam studies of reaction dynamics.** Lee, Y.T. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The major thrust of this research project is two-fold: (1) to elucidate detailed dynamics of simple elementary reactions which are theoretically important and to unravel the mechanism of complex chemical reactions or photo chemical processes which play an important role in many macroscopic processes and (2) to determine the energetics of polyatomic free radicals using microscopic experimental methods. Most of the information is derived from measurement of the product fragment translational energy and angular distributions using unique molecular beam apparati designed for these purposes.

3938 (BNL—52069, pp 96-102) **Open chain or chemically bonded structure of H_2O_4, the hydroperoxyl radical dimer.** Schaefer, H.F. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The straight chain isomer H-O-O-O-O-H of H_2O_4 is of considerable current interest in combustion and atmospheric chemistry. Ab initio quantum mechanical methods have been used to study the geometrical structure, energetics, and vibrational frequencies of this species. Double zeta (DZ) and double zeta plus polarization (DZ + P) basis sets have been used in this theoretical study, the latter designated 0(9s5p1d/4s2p1d), H(4s1p/2s1p). These basis sets have been employed in conjunction with self-consistent-field (SCF) and configuration interaction (CI) methods, including variationally up to 470,935 configurations. For the straight chain isomer, stationary points of symmetry C/sub 2h/, C/sub i/, and C_1 have been identified, and correspond to Hessian indices 3, 1, and 0, respectively. The equilibrium geometry, having no elements of symmetry at all, is relatively unique. The highest level of theory (unlinked cluster

corrected DZ + P CI) predicts the straight chain structure of H_2O_4 to lie slightly lower in total energy than the cyclic two-hydrogen bond isomer. The structures for the cyclic dimer and those for the chain structure reported here represent the first complete optimizations of any H_2O_4 isomer. Both the SCF and CI energy predictions favor the cyclic structure, but the correction of the CI energetics for the effects of quadruple excitations ultimately places the chain structure lower in total energy. Indeed, the chain structure is estimated to be bound by 11 kcal/mole (DZ + P CI) with respect to two monomers, and does represent a stable structure, i.e., a minimum on the potential energy surface.

3939 (BNL—52069, pp 103-106) **Laser studies of translational-vibrational energy transfer.** Weston, R.E. Jr.; Flynn, G.W. 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The interconversion of vibrational and translational energy has a major role in chemical reaction mechanisms. They are investigating such energy transfer processes, using time-resolved infrared fluorescence and diode laser absorption spectroscopy to determine populations of vibrationally excited molecules.

3940 (BNL—52069, pp 107-110) **Kinetics of elementary atomic and radical reactions.** Gordon, R.J. (Univ. of Illinois, Chicago). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Their research program is concerned with the rates and mechanisms of elementary gas phase reactions and energy transfer processes of small molecules. They report here on three projects; the reactions of $O(^3P)$ with hydrogen molecules, the vibrational relaxation of highly excited polyatomic molecules, and electronic relaxation of singlet NH radicals.

3941 (BNL—52069, pp 111-114) **Pulse radiolysis studies of gas phase OH reactions.** Jonah, C.D.; Mulac, W.A.; Liu, A.; Bartels, D. (Argonne National Lab., IL). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The reaction rates for the reaction of OH and OD with ethylene have been measured at atmospheric pressure in argon in the presence of 15 torr of water. A pulse from an electron linac was used to create the OH (OD) radicals. The electron beam creates excited states of the argon. These excited states transfer energy to the water molecules, dissociating them to create OH radicals. The concentration of OH radicals was measured by resonance absorption by using a water microwave discharge lamp. Experiments were done to show that there was no dependence on water concentration, or on initial concentration of OH (OD) radicals. All decays could be fit satisfactorily as simple first-order decays.

3942 (BNL—52069, pp 115-118) **Kinetic and mechanistic studies of hydrocarbon oxidation.** Tully, F.P.; Droege, A.T. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The free radicals OH and $O(^3P)$ are critical intermediates in hydrocarbon oxidation. In this research program they study the reactions of these species with aliphatic hydrocarbons using the laser photolysis/laser-induced fluorescence technique. Deuterium substitution in the hydrocarbon is utilized to provide mechanistic and kinetic data on these reactions.

3943 (BNL—52069, pp 120-122) **Kinetics data base for combustion chemistry.** Herron, J.T.; Tsang, W.; Hampson, R.F. (National Bureau of Standards, Gaithersburg, MD). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This work is concerned with the development of a chemical kinetics data base for the elementary single - step thermal reactions relevant to the combustion of organic fuels. The goal is to provide a single set of best values of rate constants that can be used by modelers and chemical kineticists. The starting point was a study of the methane oxidation system. Every possible reaction involving all possible C, O and H containing species having one or two carbon atoms was considered. That included, as a subset, all of the reactions of H, O, OH, HO_2, O_2, CO, CO_2, etc., which are basic to all combustion systems. The completed work includes data on 293 elementary reactions of 25 species. It was issued initially as an NBS report. The final version will be published in the Journal of Physical and Chemical Reference Data (October 1986). This data base has now been extended to the C_3 and C_4 hydrocarbons and to the oxygen containing C_2 species not included in the earlier work. This involves data on an additional 270 elementary reactions, bringing the total number of reactions in the data base to about 550. These will be issued initially as NBS reports (summer 1986) and in final form as particles in the Journal of Physical and Chemical Reference Data. A companion report to be issued this year will be a compilation of data on combustion chemistry covering the period 1972-1982. This will include data on 1780 reactions.

3944 (BNL—52069, pp 122-123) **Spectroscopic and dynamical studies of acetylene and hydrogen cyanide: S_0 surfaces, unstable isomers, and triplet states.** Kinsey, J.L.; Field, R.W. (Massachusetts Institute of Technology, Cambridge). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The authors studies of highly excited vibrational levels of the acetylene S_0 state have continued. Stimulated Emission Pumping (SEP) spectroscopy has been applied to the 11,000 - 18,000 cm^{-1} and 26,000 - 28,000 cm^{-1} regions in an attempt to understand the evolution from regular, assignable, localized behavior at low energy to irregular, intrinsically unassignable, quantum ergodic behavior at high energy. Fundamental questions are raised by the SEP spectra: vibrational density of states calculations appear to underestimate the ell-sorted (ell is the total vibrational angular momentum) state density especially for ell = 2; ell = 0 seems to remain well defined (a conserved observable) at all energies yet ell = 2 preparations seem to delocalize into vastly more eigenstates than ell = 0 preparations near and above the energy of the ab initio barrier for acetylene equivalent to vinylidene isomerization. Several statistical measures of quantum ergodicity (QE) have been applied to the SEP spectra. These include tests based on nearest neighbor energy separations, deviations of resolved transition intensities from a smooth Lorentzian envelope of a feature containing ~ 50 transitions, and the Fourier transform of the spectrum. The acetylene SEP spectra provide a testing ground for measures of quantum ergodicity as well as an opportunity to refine concepts of what phase space is accessible, how does the resolution of an experiment or the finite density of states restrict the time interval during which the dynamical exploration of phase space may be sampled, and how uniformly is the accessible phase space sampled.

3945 (BNL—52069, pp 124) **Electronic spectroscopy and kinetics of small molecules of interest in combustion.** Rumbles, G.; Lee, E.K.C. (Univ. of California, Irvine). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The objective of their research is to study the vibrational and rotational structure of excited small polyatomic molecules of interest in combustion, particularly their state-to-state intramolecular dynamics and bimolecular relaxation and kinetics as influenced by rotational and vibrational excitation specified by appropriate quantum numbers. Excited transient species are produced by gas phase photolysis with a tunable pulsed laser and they are probed with a second tunable laser. The rates of radiative transitions, nonradiative relaxation, and chemical processes with state resolution will be measured. The main spectroscopic probe utilized is laser induced fluorescence complimented by multiphoton ionization technique. In the last several months their main effort has been directed

for acquiring equipment such as tunable, pulsed photolysis laser, 100 MHz digital transient recorder, and pc-based data acquisition system and for setting up the laser photolysis/fluorescence detection apparatus. They are currently using this new experimental setup to evaluate the possibility for improving the photochemical generation method and LIF detection scheme for HCO radical which were used earlier in their laboratory.

3946 (BNL—52069, pp 125-126) **Energy partitioning in elementary gas phase processes.** Bersohn, R. (Columbia Univ., New York, NY). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Hydrogen atoms and chemical reactions releasing them have been the focus of their recent work. The hydrogen atoms are detected by laser induced fluorescence using the method of Wallenstein in which intense 364.8 nm light is focused in a Kr gas cell to produce a weak but adequate source of Lyman alpha light. Because of a difference in reduced mass the deuterium atom 1s → 2p absorption is shifted 22 cm^{-1} from that of the hydrogen atom. The following three exothermic reactions: (1) $F(^2P) + H_2 = HF + H - \Delta H_0 = -32$ kcal/mol; (2) $O(^1D) + H_2 = OH + H - \Delta H_0 = -43$ kcal/mol; (3) $S(^1D) + H_2 = SH + H - \Delta H_0 = -5$ kcal/mol; were studied using various isotopic modifications. The H/D atom ratio was measured when the reactants were A + HD and when the reactants were A + an equimolar mixture of H_2 and D_2.

3947 (BNL—52069, pp 127-129) **IR Dissociation spectroscopy of ethylene bonded to CH_4, CH_2D_2 and CD_4 and intramolecular dynamics of $NeCl_2$.** Janda, K.C. (Univ. of Pittsburgh, PA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The goal of my project is to understand how intramolecular vibrational relaxation effects the high resolution spectroscopy of vibrationally excited molecules. Their first results indicated that for molecular complexes of ethylene, vibrationally excited in the nu_7 out-of-plane bending mode, IVR is so fast that high resolution spectroscopy is vitiated by lifetime broadening. Only for rare gas-ethylene complexes was rotational resolution achieved. These results led them to postulate that IVR in ethylene complexes occurs by a V-T,R mechanism where the rate is limited by angular momentum constraints.

3948 (BNL—52069, pp 130-134) **Ring opening of cyclopropylidenes to allenes: reactions with bifurcating transition regions, free internal motions, steric hindrances and long-range dipolar interactions.** Valtazanos, P.; Elbert, S.T.; Ruedenberg, K. (Iowa State Univ., Ames). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The mechanism of the ring opening of cyclopropylidenes to form allene is presented. In order to characterize the reaction path, a three parameter energy surface is defined. Careful examination of the computed energy surface leads to a complete description of the reaction pathway.

3949 (BNL—52069, pp 135) **Energy transfer properties and mechanisms.** Barker, J.R. (Univ. of Michigan, Ann Arbor). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The objective of this program is to study the mechanisms and properties of energy transfer involving moderate-sized molecules. In part, the investigation is aimed at resolving current controversies about the temperature-dependence and energy-dependence of the average energy transfer step-size in deactivating collisions. To resolve the controversies, new experimental data obtained with improved techniques are necessary. Time- and wavelength-resolved infrared fluorescence is used to monitor the vibrational energy in excited molecules prepared by pulsed laser excitation. The improvements in experimental techniques include (1) tunable ultraviolet laser excitation in addition to tunable excitation in the visible and (2) optoacoustic monitoring of absorbed laser energy, which reduces uncertainties in measurements of laser power and vapor pressure. This study will include several molecules that have been investigated previously by time-resolved ultraviolet absorption. A second phase of this program is concerned with modeling of the energy transfer process and infrared emission from highly excited molecules. At present, they are developing a numerical technique for calculating densities of states for coupled, anharmonic vibrational and rotational degrees of freedom, such as are encountered in small molecules excited to energies near their dissociation limits. They have also carried out calculations to predict the infrared emission spectra of highly vibrationally excited polycyclic aromatic hydrocarbons, such as those that appear to be present in interstellar dust clouds. This work should be published shortly.

3950 (BNL—52069, pp 136) **Laser photolytic spectroscopies for measurement of reaction rates and heats of formation.** Halpern, J.B.; Okabe, H. (Howard Univ., Washington, DC). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Laser photolysis is used to produce gas phase free radicals. A tunable laser is used to measure the heat of formation of RO radicals where R = CH_3, C_2H_5, and t-C_4H_9. An excimer laser is used to produce a detectable quantity of C_2H and the reaction kinetics are followed. The excimer laser is also used to produce a sufficient concentration of free radicals permitting electric dipole transitions that can be detected by ESR spectroscopy.

3951 (BNL—52069, pp 137-138) **Rotational state distribution of CO photofragments from triplet of ketene.** Bitto, H.; Chen, I.; Moore, C.B. 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—). Contract AC03-76SF00098.

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The nascent rotational state distribution of CO ($v = 0, J''$) following excimer laser photolysis of ketene at 351 nm has been determined under collisionless conditions in a flow cell. At this low excitation energy dissociation can only take place on the triplet potential surface. Triplet ketene is probably produced by intersystem crossing rather than directly by optical excitation: CH_2CO + 351 nm → CH_2CO → $^3CH_2CO$ → $^3CH_2$ + 3.8 kcal/mol. With this available energy only the vibrational ground state can be populated. The observed rotational distribution of CO ($v=0$) deviates drastically from a phase space theory statistical distribution as well as from a thermal one. A Boltzmann plot of this distribution increases monotonically from $J''=0$ to its maximum at $J''=13$. Data in the range $J''=20$-28 can be characterized by a temperature of T=330 K. The non-statistical behavior is attributed to a barrier along the dissociation path.

3952 (BNL—52069, pp 139-141) **Anisotropic intermolecular potential surfaces from far infrared laser spectroscopy of van der Waals bonds.** Saykally, R.J. (Lawrence Berkeley Labs., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Understanding the intermolecular forces that control the processes of liquefaction, particle formation, and gas phase collision dynamics which strongly influence the nature of solids, liquids and gases themselves, has been a principal goal of physical chemistry. Various routes to this knowledge have been explored. While tremendous progress in their understanding of intermolecular forces has evolved from these studies, one essential element of these interactions has largely eluded them, even from the most sophisticated beam experiments, viz. the anisotropy of the intermolecular forces. They have developed a new experiment which will provide detailed anisotropic intermolecular potential surfaces for simple systems. Molecules bound by the van der Waals forces are formed in a supersonic expansion near 5°K, and the vibrational motions of the van der Waals bond are measured by intracavity far infrared laser techniques. These vibrations generally occur in the range 10-100

cm^{-1}, and have not previously been accessible to precise measurement. They have measured the fundamental bending vibration (π bend) of the linear Ar-HCl complex occurring near 34 cm^{-1}. Vibration-rotation transitions revealing quadrupole hyperfine structure of the chlorine nucleus were observed with signal-to-noise ratios exceeding 10^4. Analysis of these spectra confirm the presence of another excited bending state below that correlating to $v=1$ in the strong anisotropy limit, as predicted from models of the Ar-HCl van der Waals surface. This, in turn, implies the existence of two collinear attractive wells in the Ar-HCl intermolecular potential.

3953 (BNL—52069, pp 142-145) **Application of the BAC-MP4 quantum chemistry method to chemical reactions in combustion.** Melius, C.F.; Binkley, J.S.; Koszykowski, M.L. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The BAC-MP4 method, which has been used to provide a thermochemical data base of heats of formation of hydrogen, carbon, nitrogen, oxygen, and fluorine compounds of importance in combustion chemistry is being extended to include sulfur compounds. In particular, they are interested in molecular species involving sulfur with hydrogen, carbon, and oxygen arising from the combustion of fuel-bound sulfur and the formation of SO/sub x/ pollutants. They therefore have performed MP4 calculations on prototype sulfur molecules in order to develop bond-additivity-corrections for S-H, S-C, and S-O bonds. The resulting BAC-MP4 heats of formation are presented in the table. As one can see, the comparisons with the experimental data are quite good. However, the agreement for the sulfur compounds, which involves a second row atom, is not as good as for the molecules involving only first row atoms. Various bond-additivity-correction algorithms are being investigated to improve the agreement. For the sulfur-oxygen species, no experimental heats of formation of S-O single bonded sulfur compounds are available for determining the correction factor. They therefore, have used a value based on S-C and first row-first row BAC corrections. The resulting BAC-MP4 heats of formation of various SO/sub x/-related species given in the table are reasonable, including the SO_3-H_2O complex involved in the reaction of $SO_3 + H_2O \rightarrow H_2SO_4$.

3954 (BNL—52069, pp 146-149) **Energetics and dynamics of molecular collision processes: quasiclassical and semiclassical calculations of reaction dynamics.** Muckerman, J.T. 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Recent work in this program has focused on two quite different types of reactive scattering calculations. One is a detailed re-examination of the dynamics of the reaction of $O(^1D)$ with HD, which is of interest both because of recent experimental measurements of the branching ratio and because this system appears to represent an intermediate case between dynamical and statistical behavior. The second type of calculation is an application of a new semiclassical (classical path) method developed in this program to a three-dimensional direct reaction. $O(^1D)$ + HD revisited. A recent experimental study of branching ratios in A + HD reactions has shown that their prediction that the Ad/AH ratio should be greater than unit for insertion/decomposition reactions, but less than unity for abstraction reactions, is qualitatively correct. There is, however, a severe discrepancy for $O(^1D)$ + HD between the results of their previous quasiclassical trajectory calculation, which gave a value of ca. 4.5, and the experimental result of 1.13 +/- 0.08. In an effort to understand this discrepancy, they have carried out extensive new quasiclassical trajectory calculations on the $O(^1D)$ + HD system using the WMF2 potential and an improved code (both in speed and accuracy) for computing trajectories on a Diatomics-In-Molecules (DIM) potential. One objective of this work was to determine the energy dependence of the OD/OH branching ratio and other properties influenced by the finite lifetime of an intermediate HDO complex. All calculations reported here were performed on an FPS 364 Advanced Processor.

3955 (BNL—52069, pp 150-153) **State-to-state dynamics of molecular energy transfer.** Gentry, W.R.; Giese, C.F. (Univ. of Minnesota, Minneapolis). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

During the first award period for this project, a large part of their effort went into developing techniques for acquiring and interpreting data obtained with their new pulsed molecular beam apparatus. The remainder has gone into carrying out investigations on several prototypical systems involving excitation of a diatom, I_2, and two polyatomic molecules, aniline and p-difluorobenzene. These warm-up experiments have been very fruitful, and the quality of the inelastic scattering data from their new apparatus has exceeded their original expectations. I_2 was chosen for their first experiments because of its convenient spectroscopy and because its rovibrational energy level structure is significantly different from those of the other systems for which state-resolved microscopic cross sections have been measured. They were able to produce extremely cold and nearly monoenergetic beams by seeding I_2 at only about 1 torr partial pressure into H_2 or He carrier gas at about 10^4 torr total pressure. Even with such small I_2 concentrations, the sensitivity of their experiments was sufficient to measure probabilities of inelastic events per hard sphere collision which were in some cases less than 10^{-6}. This sensitivity was largely due to their development of an extremely efficient optical baffle system which enabled us to obtain 10% collection efficiency for the molecular fluorescence while reducing the scattered light level (without the use of filters) to 1 in 10^{15} laser photons.

3956 (BNL—52069, pp 154-155) **Studies in dynamics and kinetics phenomena.** Rabitz, H. (Princeton Univ., NJ). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The goal of this work is to understand the relationship between dynamical observables (e.g., cross sections, rate constants, relaxation times, etc.) and the structure of the underlying intermolecular potential surface. A related goal is to understand the degree to which a particular set of observables may be used to establish a potential by means of inversion of the data. At the present time they are not attempting to develop explicit inversion algorithms but rather they are exploring the utility of different classes of experimental data for this ultimate purpose. All of these questions are being addressed by specialized techniques of functional sensitivity analysis by means of forward $\delta\sigma$/sub i//δV(r) and inverse δV(r)/$\delta\sigma$/sub i/ sensitivity densities. These densities provide direct quantitative measures of the relationship between the i-th cross section σ/sub i/ and the potential surface V(r). Problems from elastic, inelastic and reactive scattering are being explored using both classical and quantum mechanical techniques. A summary of the current results is given. As a continuation of previous efforts in chemical kinetics they have been studying the importance of mechanistic steps in purely temporal, spatial and space-time kinetic system. Some of these activities have been carried out in collaboration with Fred Dryer at Princeton. The most important general result emerging from all these studies is the distinct presence of scaling and self similarity relations connecting the sensitivity coefficients. In the case of flame systems where a significant rise in temperature occurs it has consistently been found that all the system sensitivities are driven by the strong dominant role played by the temperature.

3957 (BNL—52069, pp 156-158) **Theoretical studies of molecular interactions.** Lester, W.A. Jr. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The goal of this program is to extend fundamental knowledge of combustion processes by theoretical studies of the dynamics of energy transfer, reactive, and photodissociative processes. The approach is based on the reliable description of inter- and intramolecular interactions using ab initio methods and a variety of ap-

proaches to describe the dynamics of nuclear motion. A summary of recent results and future plans is given.

3958 (BNL—52069, pp 159-163) **Theory of atomic and molecular collision processes.** Miller, W.H. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This research is primarily involved with the development of theoretical methods and models for describing atomic and molecular collision processes. Current projects include quantum mechanical reaction scattering and reaction dynamics in polyatomic molecular systems.

3959 (BNL—52069, pp 164-168) **Variational transition state theory.** Truhlar, D.G. (Univ. of Minnesota, Minneapolis). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This project is concerned with the development and applications of generalized transition state theory and multidimensional tunneling approximations to chemical reaction rates. They have developed and implemented several practical versions of variational transition state theory (VTST), namely canonical variational theory (CVT), improved canonical variational theory (ICVT), and microcanonical variational theory (μVT). They have also developed and implemented several accurate multidimensional semiclassical tunneling approximations, the most accurate of which are the small-curvature semiclassical adiabatic (SCSA), large-curvature version-3 (LC3), and least-action (LA) approximations. They have applied the methods to thermal rate constants, using transmission coefficients based on ground-state tunneling, and they have also presented and applied adiabatic and diabatic extensions to calculated rate constants for vibrationally excited reactants. Their general goal is to develop accurate methods for calculating chemical reaction rate constants that remain practical even for reasonably complicated molecules. The approximations mentioned above yield rate constants for systems whose potential energy surface is known or assumed. Thus a second, equally important aspect of their work is the determination or modeling, semi-empirically and/or from electronic structure calculations, of potential energy surfaces.

3960 (BNL—52069, pp 169-170) **Studies in spectroscopy and chemical dynamics.** Kuppermann, A. (California Institute of Technology, Pasadena). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Free radicals containing carbon, hydrogen, nitrogen or oxygen are of major importance for combustion processes. Many of these have low lying electronic states, which may be energetically accessible at the temperatures which occur under combustion conditions. The lowest of these states are usually expected to be of different spin multiplicity than the ground state, and once formed they are metastable with respect to the emission of radiation and may undergo chemical reactions. The experimental investigation of these states by optical spectroscopy is difficult because of the spin-forbidden nature of optical transitions connecting them to the ground state. They have started to use the technique of low energy-variable angle electron impact spectroscopy to study the electronic states of free radicals of importance to combustion processes. The phenomenon of electron exchange scattering permits one to overcome the optical selection rule against spin-forbidden transitions. The electronic spectrum of CH_3 was the first one investigated. Three pyrolitic precursors were tried: tetra methyl tin, ethyl nitrite and di-t-butyl peroxide. The spectra of these precursors were obtained. Using di-t-butyl-peroxide, relative differential cross sections for the lowest allowed A''_2 3s Rydberg transition in CH_3 (5.73 eV) were determined at incident energies of 50 eV and 25 eV. The behavior of the differential cross section for this band is analagous to that of a spin-allowed transition in a closed shell system and, as expected, in the vicinity of this band no transition of a spin-forbidden nature is detected. Work is now proceeding in testing possible sources of CH_3 and of OH.

3961 (BNL—52069, pp 171-172) **Kinetics of reactions of cyano compounds at high temperatures.** Hanson, R.K.; Bowman, C.T.; Masten, D. (Stanford Univ., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The objective of the present research is to obtain high-temperature kinetic data for reactions involving HCN, CN and NCO. These data are relevant to the formulation of reaction mechanisms for pollutant formation in flames. Reactions of interest include the reactions of these species with O and OH. Incident shock waves are used to heat various gas mixtures containing HCN, C_2N_2 or NHCO, and spectroscopic diagnostics are employed to monitor time-histories of important species during reaction. The measured concentration profiles are compared with profiles calculated using a detailed kinetic model, thereby yielding data on relevant rate coefficients.

3962 (BNL—52069, pp 173-175) **Simultaneous multipoint measurements of density gradients and temperature in a flame.** Long, M.B. (Yale Univ., New Haven, CT). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The goal of their research is the development and application of nonintrusive optical techniques for making two- and three-dimensional measurements in turbulent reacting flows. The quantitative data available from these experiments should give new insight into the topology of large-scale structures in turbulent flames and be useful for studying the interaction of turbulence and combustion. In their previous experiments, various scattering mechanisms (Lorenz-Mie, Rayleigh, Raman, and fluorescence) have been employed to measure quantities such as species concentrations, temperature, and density within a cross section of flames and jets. They have recently developed a new technique which allows simultaneous measurement of all three components of the gradient of such a scalar within the same plane. Using Rayleigh scattering, they have successfully applied the technique in measuring the concentration and concentration gradient vector in cross sections of a turbulent Freon jet. The technique has the potential to be used with other scattering mechanisms for the measurement of different scalar gradients.

3963 (BNL—52069, pp 176-179) **Hydrocarbon/nitric oxide - interactions in low-pressure flames.** Thorne, L.R.; Branch, M.C.; Chandler, D.W.; Kee, R.J.; Miller, J.A. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The objective of this research is to elucidate the chemistry of nitrogen-containing species as it relates to the production of NO/sub x/ during combustion, and the phenomena of multiple flame fronts. In this study, mass spectrometry, laser-induced fluorescence spectroscopy and Fourier transform infrared Spectroscopy are used to measure species concentration and temperature profiles of low pressure flames. The significance of these profiles is analyzed by modeling the same profiles using full flame structure calculations that incorporate transport and detailed chemical reaction kinetics. Reaction-rate sensitivity coefficients and product-rate information calculated in the model are used to develop a combustion mechanism for the class of flames under investigation. An important adjunct to this work is obtaining and evaluating absorption and emission spectra of important combustion species. This activity provides information necessary to make quantitative concentration measurements of these species in flames using non-perturbing optical techniques.

3964 (BNL—52069, pp 180-183) **High-resolution coherent anti-Stokes Raman spectroscopy.** Farrow, R.L.; Lucht, R.P. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The continued development of CARS as a combustion research tool calls for increasingly accurate knowledge of spectroscopic parameters such as Raman linewidths, lineshapes, and transition frequencies, and nonresonant electronic susceptibilities of combustion species. High-resolution inverse Raman spectroscopy (IRS) has been invaluable in providing Raman linewidths for N_2 and CO, as well as accurate molecular constants. However, this technique has limited sensitivity for in situ investigations, and does not provide nonresonant susceptibilities. While similar high-resolution CARS systems have been used for general spectroscopy, they know of no applications of such systems to combustion environments. They have constructed a high-resolution CARS experiment based on single-frequency Nd:YAG and pulse-amplified ring dye lasers, and used this system to obtain fully resolved CARS spectra of CO and N_2 in flames. Raman Q-branch linewidths of CO analyzed from this data are compared to published infrared linewidths. Nonresonant susceptibilities were also measured using a lower resolution, but broadly tunable, pulsed dye laser. The results demonstrate that high-resolution CARS is a useful tool for providing needed spectroscopic properties of combustion gases.

3965 (BNL—52069, pp 184-187) **CARS temperature measurements in the unburned gas region of an internal combustion engine.** Lucht, R.P. (Sandia National Lab., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Broadband, coherent anti-Stokes Raman scattering (CARS) temperature measurements have been performed in the unburned gas region of an internal combustion engine. CARS measurements in high pressure gases, such as those encountered in an engine, are complicated by collisional narrowing of the spectrum. At the temperatures of interest in this study (500-1100K), accurate temperature measurements are especially difficult because the first vibrational hot band of nitrogen is very weak. Thus, temperature information is contained primarily in the shape and width of the nitrogen fundamental band, and it is critically important that the physics of processes such as collisional narrowing are well modeled.

3966 (BNL—52069, pp 188-191) **Far-UV fluorescence techniques for combustion diagnostics.** Goldsmith, J.E.M. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Most of the atomic and diatomic radicals of primary interest in combustion studies have been detected in flames with laser-induced fluorescence (LIF) techniques, using either conventional (single-photon) or multiphoton excitation schemes. Many questions still must be answered before quantitative applications of these methods can become routine, however. They are attempting to address some of these issues, with particular emphasis on the applicability of multiphoton excitation techniques for making quantitative measurements in combustion environments. They have recently investigated the application of 205-nm, two-photon-excited fluorescence detection for measuring relative [H] profiles in atmospheric-pressure flames.

3967 (BNL—52069, pp 192-195) **High resolution coherent Raman spectroscopy.** Rahn, L.A.; Palmer, R.E.; Koszykowski, M.L. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Coherent anti-Stokes Raman spectroscopy (CARS) has received wide acceptance in combustion research for the measurement of temperature and major species concentrations. The primary advantage of this diagnostic technique is its superior rejection of background radiation because of the strength and coherence of the signal generated by the nonlinear four-wave-mixing CARS process. This nonlinear process, however, is also responsible for increased complexity in the analysis of the measured spectra, since the CARS signal depends nonlinearly on the Raman susceptibility of the combustion gases. The resulting need for accurate spectral models of combustion gases requires detailed studies of Raman linewidths, lineshapes, and Raman and nonresonant susceptibilities. Quasi-cw inverse Raman spectroscopy (IRS) is used in this project to make precise, high-resolution measurements of the Raman spectra of combustion-related molecules and to extract from these measurements the information required to model CARS spectra in combustion environments. In the IRS technique, a pulsed pump laser induces a small absorption in a cw probe laser via the stimulated Raman effect. The primary advantages of IRS are that the signal intensity has a linear dependence on the imaginary part of the third-order nonlinear susceptibility, and the spectral resolution is limited only by the linewidths of the lasers used. The present apparatus has a spectral resolution of +/- 0.0015 cm^{-1} and Raman shift accuracy of +/- 0.001 cm^{-1}.

3968 (BNL—52069, pp 196-199) **Laser-Fluorescence imaging of nitrogen dioxide.** Cattolica, R.J. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Two-dimensional imaging of transient and unsteady combustion processes using planar laser-induced fluorescence has become an important new experimental technique. To visualize flame propagation, a new fluorescence imaging technique based on doping the reactant gas with nitrogen dioxide was developed. The NO_2 molecule has a number of characteristics which make it a useful fluorescence source for combustion applications. It disappears readily in the reaction zone of a flame and can be excited by a variety of laser systems, both continuous and pulsed, in the visible wavelengths (400-600 nm). In the development of this laser-induced fluorescence (LIF) imaging technique a trace concentration (700 ppm) of NO_2 molecules was used to visualize the propagation of a flame in a stoichiometric methane-air mixture in a constant-volume combustion chamber. The disappearance of NO_2, reflected in the elimination of the LIF signal, was used to mark the progress of the flame front as a spark-ignited flame propagated across the constant-volume combustion chamber.

3969 (BNL—52069, pp 200-203) **Chemical structure of turbulent nonpremixed flames of methane near extinction.** Dibble, R.W. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The objective of the turbulent flame research is to develop an increased understanding of the coupling between chemical kinetic and turbulent transport processes occurring in chemically reacting flows, and to utilize this understanding to improve predictive capabilities for turbulent combustion. To this end, they cite progress in three research areas: departure from equilibrium in a turbulent hydrocarbon phase using Raman scattering, fluorescence interference with Raman measurements, and collected data from turbulent reactive flow studies in a vertical combustion tunnel.

3970 (BNL—52069, pp 204-208) **Two-Dimensional imaging of CH_4 and CH in aerodynamically stabilized flames.** Schefer, R.W.; Johnston, S.C.; Namazian, M.; Kelly, J.; Long, M.B. (Sandia National Labs., Livermore, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

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Two-dimensional Raman and laser-induced fluorescence imaging were used to measure the CH_4 and CH concentration fields, respectively, in an idealized bluff-body burner. Methane fuel was supplied through the center of the bluff body at a velocity of 25 m/sec, giving a Reynolds number of 14,000 based on the fuel jet exit diameter. Air was supplied through a coaxial jet surrounding the bluff body at a velocity of 25 m/s.

3971 (BNL—52069, pp 209-212) **Measurement of species concentrations in flames by laser-induced fluorescence.** Salmon, J.T.; Peterson, D.L.; Nagy, P.A.; Lytle, F.E.; Laurendeau, N.M. (Purdue Univ., West Lafayette, IN). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

The primary goal of this research is to develop quantitative laser fluorescence methods for measuring the concentrations of intermediate species that are important in the chemistry of flames. The accuracy of the fluorescence techniques is assessed through comparison with independent diagnostic methods. The applicability of the techniques over a range of flame conditions is evaluated by performing the fluorescence experiments in a flat flame burner operated at a variety of flame pressures, temperatures and equivalence ratios. Recent progress has included (1) the application of photoionization controlled-loss spectroscopy (PICLS) to detect atomic hydrogen in flames and (2) the development of a flame temperature diagnostic using the anomalous fluorescence of pyrene. They are investigating photoionization controlled-loss spectroscopy (PICLS) as a means of obtaining absolute number densities of atomic hydrogen from fluorescence measurements in both $H_2/O_2/N_2$ and $C_2H_4/O_2/Ar$ flames. This work is an extension of the two-photon fluorescence measurements of atomic hydrogen that were conducted in their laboratory several years ago.

3972 (BNL—52069, pp 213-216) **Low energy ion-molecule reactions.** Farrar, J.M. (Univ. of Rochester, NY). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

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The authors work during the past year has focused on several problems in the condensation reactions of C^+ and CH_3^+ with small molecules, particularly hydrocarbons. Their emphasis has been on understanding the dynamics of collision complex formation and isomerization of transient intermediates along the reaction coordinate. In many ionic reactions, intermediates having non-classical valence structures may be nearly as stable as their classical analogs, in contrast with neutral systems where the non-classical structures are much less stable. The $C^+ + NH_3$ system shows this behavior, indicating that the non-classical $HCNH_3^+$ structure formed by insertion of C^+ into the N-H bond serves as a precursor to the products. N-H bond cleavage in this intermediate to form $HCNH^+$ occurs over a large barrier and occurs more readily than the 1,2 hydrogen atom shift to form the classical $H_2C = NH^+$ intermediate. Their experimental kinetic energy distribution for this channel is consistent with the presence of a large exit channel barrier. Their recently published work on $C^+ + H_2O$ also demonstrates this phenomenon. The $CHOH^+$ hydroxycarbene cation serves as the initial intermediate and isomerization to the classical H_2CO^+ cation is competitive with O-H or C-H cleavage to yield the formyl, HCO^+, or isoformyl, COH^+, cations. They have also completed studies on the reactions of C^+ with O_2, CH_3OH, HCN, and the two-carbon containing hydrocarbons ethane, ethylene, and acetylene.

3973 (BNL—52069, pp 217-219) **Infrared absorption spectroscopy and chemical kinetics of free radicals.** Curl, R.F.; Glass, G.P. (Rice Univ., Houston, TX). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

A color center laser spectrometer is being employed to investigate the spectra and reactions of free radicals. Two basic approaches are used. In the first, a DC electrical discharge inside a multiple reflection absorption cell is probed by the laser beam. By the detection of magnetic rotation of the laser polarization, detection is limited to paramagnetic species, and the sensitivity is improved. With this system, the spectra of C_2H, C_2D, and C_2 have been investigated. In this report, the spectrum of C_2D will be discussed. In the second approach, free radical species are produced by excimer laser flash photolysis of a suitable precursor and detected in transient infrared absorption. The resulting time-resolved spectra may be used for kinetic mechanism studies. In this report, an investigation of the DENOX reaction will be described.

3974 (BNL—52069, pp 220-222) **Spectroscopic studies of short-lived molecular species.** Sears, T.J. 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This work is directed toward the understanding of the structure and dynamics of short-lived intermediates in gas phase chemical reactions. Interest is centered on molecular free radicals and ions with the aim of determining inter- and intra-molecular potential functions and details of molecular electronic structure.

3975 (BNL—52069, pp 223-226) **Combustion gas spectroscopy using tunable lasers.** Hanson, R.K. (Stanford Univ., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This research is concerned with the development and application of tunable laser techniques for the measurement of fundamental spectroscopic parameters (line and oscillator strengths, collision linewidths and fluorescence quenching factors) of combustion species. Fast-scanning cw laser sources utilized include an infrared diode laser and a visible/UV ring dye laser.

3976 (BNL—52069, pp 227-230) **Picosecond CO_2 laser study of polyatomic molecules.** Kwok, H.S. (State Univ. of New York, Buffalo). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This project concerns the study of the properties of vibrationally hot molecules with picosecond duration CO_2 laser pulses. The CO_2 laser is tunable in wavelength in order to probe various vibrational modes, as well as adjustable in duration in order to study the dynamical effects in the absorption process. Various polyatomic molecules having resonances in the 9-11 μm region are investigated, including SF_6, C_2F_3C ell, C_3F_7I and CF_3I. Single beam transmission measurements as well as double resonance experiments were performed. The results indicate dynamic behaviors in these molecules which are quite different from nanosecond pulse interactions.

3977 (BNL—52069, pp 231-234) **Resonance ionization and photoelectron spectra of Rydberg molecules.** Johnson, P.M. (State Univ. of New York, Stony Brook). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Multiphoton ionization (MPI) has found great success in elucidating the structure and dynamics of atomic and molecular systems. The development of an efficient supersonic beam source for producing metastables has enabled them to study these systems using MPI. They have successfully observed and studied the CC1 radical, triplet benzene and more recently several metastable states of molecular nitrogen, including the discovery of a new Rydberg series originating from the E $^3\Sigma$/sub g/$^+$ (3s) state.

3978 (BNL—52069, pp 235-236) **Time-Resolved studies of free radicals and laser-initiated chain reactions.** Leone, S.R. (Univ. of Colorado, Boulder). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Efforts in progress include further work on the generation of free radicals by various selective photolysis mechanisms and the study of the reactivity and energy transfer of these radicals with other species. These studies are carried out by excimer laser photolysis and time- and wavelength-resolved, low resolution infrared emission detection. A new experimental arrangement to probe high resolution features of these radicals produced upon photolysis and their subsequent reactions is being developed by adapting a Fourier Transform Infrared Spectrometer (FTIR) for use in emission. New data has been acquired on the photolysis of acetone at 193 nm

under a variety of conditions of varying buffer gas density and precursor pressure to investigate the dynamics of the photodissociation. This problem is of interest because the dissociation produces two methyl radicals and CO, and is thus categorized as a three-body dissociation mechanism. An important question concerning multi-body dissociation is whether the process is concerted or occurs in a stepwise fashion. Data from their experiments gives a strong indication that the dissociation of acetone is a two-step process.

3979 (BNL—52069, pp 237-241) **Vibrational state-selected study of the reaction H_3^+(v/sub o/'=1-4) + H_2(v/sub o/"=0) → H_3^+ + H. Ng, C.Y. (Iowa State Univ., Ames). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).**

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Proton transfer represents one of the fastest and most important classes of reactions in both the gas and condensed phases. The simplicity of the proton transfer reaction H_3^+(v/sub o/') + H_2(v''=0) → H_3^+ + H makes it a system of fundamental importance to molecular reaction dynamics. Recently, several reliable theoretical calculations on reaction (1) have been reported. Stine and Muckerman have applied a variant of the trajectory surface hopping (TSH) method on H_4^+ valence bond diatomic-in-molecule potential energy surfaces and have carried out extensive calculations on this system. Combining the similar quasiclassical trajectory approach and a newly developed Fourier transform method, Eaker and Schatz have also calculated cross sections for the H_3^+ + H channel with an emphasis on the product H_3^+ rotational and vibrational distributions. In spite of the fact that this reaction has been investigated numerous times by nearly all accessible experimental techniques, detailed state-selected cross sectional data have not yet been available to provide a critical test on these theoretical calculations. They have developed a new tandem photoionization mass spectrometer for state-selected studies of ion-molecule reactions. This apparatus, which combines the merits of photoionization, RF octopole ion guide, and tandem mass spectrometric techniques, is capable of performing absolute state-selected total cross section measurements on simple as well as more complicated ion-molecule reactions over a wide kinetic energy range. Using this apparatus, they have measured the absolute state-selected microscopic total cross sections for reaction (1) over the E/sub c.m./ range of 0.25 - 15 eV.

3980 (BNL—52069, pp 242-245) **Combustion research program flame studies, laser diagnostics, and chemical kinetics.** Crosley, D.R.; Golden, D.M.; Smith, G.P.; Jeffries, J.B. (SRI International, Menlo Park, CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

They have developed the laser pyrolysis/laser fluorescence (LP/LF) technique into a reliable method for measuring reaction rates of radical species at temperatures 800-1400 K. This temperature range greatly facilitates the extrapolation of rate data to flame temperatures. In Figure 1 are the results (o) of their direct measurement of the bimolecular reaction rate constant for the OH + NH_3 reaction over the temperature range 840-1425 K. A modified three-parameter Arrhenius form provides an excellent fit to all the data over the range 225 ≦ T ≦ 2350 K. The extrapolation of OH reaction rate constants to flame temperatures is more complex for unsaturated hydrocarbon reactants. At room temperature OH adds to the double bond in these alkenes and alkynes to form adduct compounds. Such addition reactions require a collisional stabilization step, producing a pressure dependence that is theoretically treated by an RRKM-like calculation. At high temperatures and low pressures, the addition reaction should become less important because the thermal decomposition rate of the adduct increases, there are fewer stabilizing collisions, and the collisions that do occur are less efficient. They have studied the reaction of OH with ethylene between 850 and 1200 K to examine the rate for OH abstraction of vinylic hydrogens. The low temperature data indicates that the addition channel is not important for temperatures above 700 K. They measured a reaction rate constant of 2.7 x 10^{-13} cm^3 s^{-1} at 1200 K.

3981 (BNL—52069, pp 246-248) **Laser photoelectron spectroscopy of ions.** Ellison, G.B. (Univ. of Colorado, Boulder). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This laboratory is studying the spectroscopy of reactive intermediates. They prepare mass-selected negative ion beams (M^-) and irradiate them with an intracavity, CW Ar II laser operating on a single line (λ_0 = 488 nm). Following detachment of the ions, they energy analyze the scattered electrons. M^- + h omega$_0$ => M + e^-. From an analysis of the resulting photoelectron spectrum, one is able to deduce the electron affinity of the neutral (M) as well as the heats of formation of M and M^-. In addition it is generally possible to carry out a successful Franck-Condon analysis and to extract the molecular geometries of the negative ion and the final neutral. They have completed a study of the related ions, SO_2^-, S_3^-, and S_2O^-.

3982 (BNL—52069, pp 249-252) **Investigation of OH dynamics in the argon sensitized pulse radiolysis of water vapor.** Bera, R.K.; Hanrahan, R.J. (Univ. of Florida, Gainesville). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Reactions of OH radical were studied in systems containing 650 torr Ar and from 0.5 to 9 torr H_2O using the method of pulse radiolysis-absorption spectroscopy. It was found that initial concentrations of OH radical increased as a function of water vapor pressure. Although loss of OH with time followed approximate second order kinetics, the raw data were fitted arbitrarily to a first order rate expression, because a second order fit requires knowledge of absolute initial OH concentrations. These can be computed from measured initial OH absorption if the extinction coefficient is known, but an accurate value was not available initially. The half-life for OH loss decreased at higher water pressures. Dependence of OH half-life on OH concentration occurs because homogeneous OH loss processes are second order in reaction intermediates, whose concentration increases with added H_2O. A contribution by water in chaperoning OH/OH and OH/H combination is also important.

3983 (BNL—52069, pp 253-256) **Direct determination of atom and radical concentrations in thermal reactions of hydrocarbons and other gases.** Skinner, G.B.; Rao, V.S. (Wright State Univ., Dayton, OH). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Their work so far has led to dependable methods for measuring H, D and O atom concentrations by resonance absorption spectroscopy, and they have applied the methods to making measurements of these atoms in several reaction systems of importance in combustion research. During the past year they have studied several reaction systems behind incident shock waves at total gas pressures of 0.2 to 0.6 atm. These include pyrolysis of ethylbenzene ($C_6D_5CD_2CD_3$ and $C_6H_5CD_2CH_3$), toluene ($C_6H_5CD_3$), butadiene ($CD_2CHCHCD_2$), and vinyl iodide (CH_2CHI).

3984 (BNL—52069, pp 257) **Laser dynamics of free radical reactions.** Jackson, W.M. (Univ. of California, Davis). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Experiments are in progress to measure the activation energy and A factor for the reaction of CN radicals with a series of saturated hydrocarbons. The rate constants for these reactions were previously determined at room temperature. From these experiments, the rate constants were found to increase from 5.6 x 10^{-13} to 2.3 x 10^{-10} cm^3 s^{-1} $molecule^{-1}$ in going from CH_4 to C_7H_{16}. The later value is too large to be explained by normal hydrogen atom abstraction reaction. To explain these results they have postulated that because of the polar nature of CN, a complex intermediate will

be formed as a result of dipole-induced-dipole interactions. This complex intermediate enhances the overall reactivity and decomposes to form products by atomic or molecular elimination. In addition to the activation energy and A factor measurements for these reactions they are in the process of determining the mechanism for these reactions by product analysis.

3985 (BNL—52069, pp 258-261) **Studies of combustion kinetics and mechanisms.** Gutman, D. (Illinois Institute of Technology, Chicago). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

Studies of the thermochemistry of RO_2 radicals have continued. Direct measurements of the equilibrium constants for the reactions $R + O_2$ equivalent to RO_2 as a function of temperature have resulted in the determination of three additional $R\text{-}O_2$ bond strengths [R=C_2H_5, t-C_4H_9 and C_3H_5]. The $R\text{-}O_2$ bond strengths for the peroxy radicals involving alkyl radicals increase with the complexity of the free radical. The trend in $R\text{-}O_2$ bond strengths as well as their magnitudes can be reproduced using group additivity estimates of the Heat of Formation of RO_2 (with a group enthalpy of O-(C)(O) revised downward by 1.9 kcal $mole^{-1}$ to 12.3 kcal $mole^{-1}$) and Heats of Formation for the alkyl radicals derived from experiments. The kinetics and mechanism of the reaction of C_3H_5 with O_2 were investigated from 293-865 K using a tubular reactor coupled to a photoionization mass spectrometer. A quantitative study of the recombination reaction, $CH_3 + CH_3 \rightarrow C_2H_6$, in the fall-off region has been initiated. The purpose of the study is to gain a better understanding of collisional effects in this overall reaction and to obtain accurate expressions for the temperature and pressure dependencies of this important reaction for use in combustion modeling.

3986 (BNL—52069, pp 262-263) **Photochemistry of materials in the stratosphere.** Johnston, H. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

This research is concerned with fundamental gas-phase photochemistry, with application to molecules and radicals that occur in the stratosphere. One goal is to measure the distribution of energy in photolysis fragments. Another goal is to obtain optical and kinetic data in the laboratory that are needed by modelers of the atmosphere. The experimental methods include laser flash photolysis, laser resonance absorption, resonance fluorescence, dispersed chemiluminescence from photolysis products, and infrared diode lasers. This research has applications to molecular dynamics, to problems of atmospheric ozone, and to the role of trace gases other than carbon dioxide on the greenhouse effect.

3987 **(LBL—23515) Pulsed plasma jet igniters: Species measurements in methane combustion.** Cavolowsky, J.A.; Breber, P.R.; Oppenheim, A.K.; Lucas, D. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 4p. (CONF-871118—7). NTIS, PC A02. Order Number DE88001389/JAW.

From Combustion Institute fall meeting; Honolulu, HI, USA (22 Nov 1987).

We have determined the mole fractions of the chemical species present in the plume of a pulsed plasma jet igniter during the ignition and subsequent combustion of methane/oxygen/nitrogen and methane/oxyen/argon mixtures. Equivalence ratios of 1.0, 0.6, and 0.4 were used in the jet cavity and in the main combustion chamber to obtain results for both combusting and noncombusting cases.

3988 **(LBL—23952) Formation and destruction of nitrous oxide in lean, premixed combustion.** Martin, R.J.; Brown, N.J. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 4p. (CONF-871118—6). NTIS, PC A02. Order Number DE88001390/JAW.

From Combustion Institute fall meeting; Honolulu, HI, USA (22 Nov 1987).

Nitrous oxide is formed in lean CH_4/air and H_2/air flames doped with various nitrogen compounds, but it does not survive into the post flame region. Nitrous oxide concentration was found to depend inversely upon final flame temperature and equivalence ratio and directly upon nitrogen compound concentration. In decreasing order of observance of early-N_2O, four nitrogen-containing dopants can be ranked: N_2O, NH_3, NO and N_2. Nitrous oxide profiles were similar in CH_4/air and H_2/air flames. Radial profile measurements showed increased amounts of N_2O existing near the burner edge. Comparison between calculated NO and N_2O profiles and those measured in an H_2/air flame showed that NO was satisfactorily predicted by the model, but that significant difficulties exist with the N_2O kinetics.

3989 **(SAND—87-8240) Summary of discussions at the ninth meeting of the Sandia Cooperative Group on the aerothermochemistry of turbulent combustion.** Dibble, R.W.; Lucht, R.P. (Sandia National Labs., Livermore, CA (USA)). Oct 1987. Contract AC04-76DR00789. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002281/JAW.

A turbulent reacting flow working group has been established through the Department of Energy/Office of Basic Energy Sciences. Purpose of this group is to establish and maintain a strong interaction and active dialogue between workers currently involved in modeling turbulent reacting flows and those involved in related experiments. One objective of this collaboration is to develop an increased understanding of the fundamental interaction between the chemical and fluid dynamical processes occurring in chemically reacting flows and to utilize this understanding to improve predictive capabilities for turbulent combustion. Regular members, who represent academia, private industry, and national laboratories, and guests participate in the meetings. Several guests are invited to each meeting to provide an influx of different ideas and opinions to the discussions. This document is a summary of the discussions that took place during the ninth meeting, which was held at UC Davis, California, April 21 and 22, 1987.

3990 **Second-order conditional modeling of turbulent nonpremixed flames with a composite pdf.** Chen, J.Y. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* 69: No. 1, 1-36(Jul 1987).

A second-order conditional model for turbulent nonpremixed flames with a composite probability density function (pdf) is presented. The composite pdf represents three parts of the scalar field: a fully turbulent part, a surrounding nonturbulent part, and a superlayer part. The conditional equations are derived using Favre averaging (density weighting) with the interfacial interaction terms appearing in explicitly separate groups. These equations are closed by a second-order scheme and models for the interfacial terms. Nitric oxide formation is computed by a model including the effects of intermittency and nonequilibrium oxygen-atom concentration. The performance of the proposed model is evaluated by comparisons of model predictions with three different sets of experimental data for turbulent nonreacting and reacting jets. The calculated results are also compared with those obtained without the consideration of the superlayer and with those predicted by an unconditional model using different pdf shapes. Although the uncertainties of the experimental data prevent us from drawing solid conclusions from these comparisons, it is shown that the model predictions can be improved by incorporating intermittency and a composite pdf. The improvements are most significant for the scalar field. The nitric oxide calculations indicate that the effect of the superlayer can be significant, suggesting the use of the proposed model in this area.

3991 **Dynamics of nonadiabatic premixed flames in a gravitational field.** Kaper, H.G.; Leaf, G.K.; Matkowsky, B.J.; Olmstead, W.E. (Mathematics and Computer Science Div., Argonne National Lab., Argonne, IL 60439-4844). *SIAM Journal on Applied Mathemadics;* 47: No. 3, 544-555(Jun 1987). Contract W-31-109-ENG-38;AC02-78ER04650.

A nonlinear stability analysis of a plane flame subject to gravitational forces and small volumetric heat loss is presented. A nonlinear partial differential equation describing the evolution and structure of the flame is derived. It is shown that the effects of vol-

umetric heat loss can be summarized in a scale factor multiplying the strength of the gravitational force field. The scale factor is a function of the heat loss coefficient.

3992 **Ignition of a combustible solid with reactant consumption.** Lasseigne, D.G.; Olmstead, W.E. (Dept. of Mathematical Sciences, Old Dominion Univ., Norfolk, VA 23508). *SIAM Journal on Applied Mathemadics;* 47: No. 2, 332-342(Apr 1987).

The effects of excessive reactant consumption on the ignition of a combustible solid are introduced through a revised scaling of the heat release constant. Large activation energy asymptotics then yields a new one-parameter integral equation governing the temperature evolution near ignition. Analysis of the integral equation reveals a critical value of the parameter which distinguishes between the cases of ignition and nonignition.

3993 **Multiplicity and related phenomena in competing reaction flames.** Clavin, P.; Fife, P.; Nicolaenko, B. (Laboratoire de Recherche en Combustion, Universite de Provence, UA-1117 CNRS, Centre St. Jerome, 13397 Marseille Cedex). *SIAM Journal on Applied Mathemadics;* 47: No. 2, 296-331(Apr 1987).

Asymptotic analysis of flame structure is carried out for some two-reaction networks of "competition" type. When the heat releases of the two reactions are ordered in the same way as their activation energies, multiplicity of traveling wave solutions is exhibited, in which more than one type of flame can result from the same unburned condition. This multiplicity phenomenon is of a purely kinetic nature, and occurs when there is a crossover temperature at which the two constants of reaction are equal. Special attention is devoted to obtaining explicit solutions as well as stability limits in transitional regions. When the ordering is opposite, the phenomenon of a temperature plateau occurs, in which the flame temperature is little affected by changes in the unburned conditions. Flame structure under this condition is also studied.

42 ENGINEERING

REFER ALSO TO CITATION(S) 4037, 5349

3994 **(CONF-871211—2) On linear periodic controllers.** Lee, S.; Meerkov, S.M. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). Dec 1987. Contract FG02-85ER13315. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87011174/JAW.

From 26. IEEE CDC conference; Los Angeles, CA, USA (9 Dec 1987).

A necessary and sufficient condition for existence of a linear periodic controller which is advantageous in problems of robust, strong and simultaneous stabilization is formulated. 7 refs.

3995 **(UCRL—52000-87-9) Energy and Technology Review, September 1987.** Lear, R.D.; Jandrisevits, R.A.; Crawford, R.B.; de Vore, L.; Gleason, K.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002244/JAW.

This issue contains an interview which highlights the Laboratory's advances and continuing involvement in the rapidly changing field of precision engineering technology. Other articles include discussions of ultraprecision measurement, precision fabrication processes, development of the Large Optics Diamond Turning Machine, and the future of precision engineering at LLNL.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 2968, 3072, 3073, 3095, 3096, 3105, 3172, 3591, 3649, 3668, 3732, 4232, 4237, 4252, 5174

3996 **(BARC—1322) Pulsed power sources based on MHD generators (A state-of-art review).** Das, A.K.; Venkatramani, N.; Rohatgi, V.K. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 95p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700296/JAW.

pulsed Power sources are finding increased applications in powering plasma experiments, CTF devices, investigations of structure of earth's crust or self-contained compact power supplies for military applications. This report reviews the development of magnetohydrodynamic (MHD) power systems for pulsed power applications. The major critical components, which are analysed in detail, include the combustor, high energy fuel development, high field magnet, high power density channel and power conditioning unit. The report concludes that the MHD research has now reached a stage, where it is possible to design and achieve requisite performance from short duration high power compact MHD generators. 28 figures, 7 tables, 27 refs.

3997 **(BARC—1330) Piping data retrieval system (PDRS): An integrated package to aid piping layout.** Vyas, K.N.; Sharma, A.; Susandhi, R.; Basu, S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700299/JAW.

An integrated package to aid piping layout has been developed and implemented on PDP-11/34 system at Hall 7. The package allows various equipments to be modelled, consisting of primitive equipment components. The equipment layout for the plant can then be reproduced in the form of drawings such as plan, elevation, isometric or perspective. The package has the built in function to perform hidden line removal among equipments. Once the equipment layout is finalised, the package aids in superimposing the piping as per the specified pipe routine. The report discusses the general capabilities and the major input requirements for the package.

3998 **(BMFT-FB-T—86-178) Chimneys and exhaust gas lines for low temperatures. Pt. 1. Boundary conditions for the removal of exhaust gases having low temperatures. Final report.** Hoess, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750013/JAW.

The exhaust gases of fireplaces are led into the open air through chimneys. If exhaust gas temperatures are too low, moisture is secreted, which leads to penetration of moisture or sooting. Tasks set for the removal of exhaust gases having low temperatures: Fundamental proposals for solutions had to be elaborated; different chimney construction types had to be tested theoretically and experimentally; the influence of secondary air had to be examined; and sample facilities had to be practically tested.

3999 **(BMFT-FB-T—86-260) Construction of a high-pressure/high-temperature precipitator (insulator support of discharge system and high-voltage bushing through the pressure-supporting wall). Final report.** Mayer-Schwinning, G.; Hartmann, W.; Leluschko, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Lurgi G.m.b.H., Frankfurt am Main (Germany, F.R.)). Dec 1986. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750132/JAW.

A high voltage bushing leading through the earthed casing wall of an electrostatic precipitator and a support insulator for the discharge system inside a tower added on top of the precipitator have been conceived to operate the deduster at temperatures of up to 900degC and pressures of up to 20 bar. With 5 figs.

4000 **(CEA-CONF—8508) Sampling by electro-erosion on irradiated materials.** Riviere, M.; Pizzanelli, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). May 1986. 29p. (In French). (CONF-8605196—3). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750099/JAW.

From EEC hot laboratories meeting; Brasimone, Italy (21 May 1986).

Sampling on irradiated materials, in particular for mechanical property study of steels in the FAST NEUTRON program needed the set in a hot cell of a machining device by electroerosion. This device allows sampling of tenacity, traction, resilience test pieces.

4001 **(CONF-860141—1) Strategic defense initiative.** Nichols, J.P. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE86006209/JAW.

From Reserve Officers Association conference; Johnson City, TN, USA (30 Jan 1986).

This collection of vugraphs states that space power reactors, neutral beams, and flywheel energy storage technologies are important areas to be investigated for application to the strategic defense initiative. (JDH)

4002 **(CONF-871211—3) Dealing with unanticipated events in autonomous navigation.** Burks, B.L.; Barnett, D.L.; Killough, S.M.; Mann, R.C.; Pin, F.G. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. Order Number DE88000590/JAW.

From 26. IEEE CDC conference; Los Angeles, CA, USA (9 Dec 1987).

In this paper, we describe advances to our mobile robot series (currently HERMIES-IIB) to include 8 NCUBE processors onboard (computationally equivalent to 8 Vax 11/780's) operating in parallel, and augmentation of the sensor suite with cameras to facilitate on-board vision analysis and goal finding. The essential capabilities of the expert system described in our earlier paper have also been ported to the on-board HERMIES-IIB computers thereby eliminating off-board computation. We describe a successful experiment in which a robot is placed in an initial arbitrary location without prior specification of the room contents, successfully discovers and navigates around stationary and occasionally moving obstacles, picks up and moves small obstacles, searches for a control panel, and reads the meters found on the panel. The success of this experiment encourages more complex on-board vision analysis and expert system control in dynamic environments. The experiment will be expanded to include research in robot learning as the robot attempts to adjust the meter reading to a particular value without a priori knowledge of the control panel system dynamics. 18 refs., 15 figs., 1 tab.

4003 **(DP-MS—86-54) Agency update: Savannah River Plant/Laboratory.** Eberhard, B.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 5p. (CONF-8703188—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014830/JAW.

From Spring meeting of the IMOG - joining subgroup committee; Rocky Flats, CO, USA (10 Mar 1987).

This paper provides a discussion of activities and status at the Savannah River Plant and Laboratory. Personnel changes are presented and a discussion of welding procedures, problems, equipment, and reliability. Reactor maintenance efforts are also presented.

4004 **(DP-MS—87-113-Del.Ver.) Operating and maintenance experience in tritium environments.** Tuer, G.L. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 16p. (CONF-8704216—1-Del.Ver.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001368/JAW.

From 48. DAMSUL committee meeting; Golden, CO, USA (29 Apr 1987).

This presentation is a summary of practical experience gained over more than twenty years from analyzing failures of process equipment operated in tritium and deuterium environments. Significant improvements have been achieved in design and procurement of new equipment, testing and selection of materials, and gradually more favorable maintenance experience. Preferred materials and inspection methods are described. 6 tabs.

4005 **(HEDL-SA—3367) A simplified system for doing ICP analysis on radioactive samples.** McCown, J.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1985. Contract AC06-76FF02170. 11p. (CONF-860114—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014369/JAW.

From American Society for Testing and Materials Committee C-26 meeting on nuclear fuel cycle; New Orleans, LA, USA (13 Jan 1986).

Methods for setting up equipment to perform analyses on radioactive materials vary considerably from one site to another. Factors include the interests of the group involved, i.e., research vs service work; the type of building containing the lab; the arrangement of the lab for contamination control; previous experiences in operating similar equipment; the local interpretation of safety regulations; and the time and money available for the task. The Chemistry and Analysis group of the Westinghouse Hanford Company performs analytical chemistry in support of many Hanford programs. Samples analyzed cover a wide variety of materials with more than 50% involving radioactivity of one type or another. All of the laboratories in the building are connected to a common exhaust system with ductwork leading to the basement. Double HEPA filtration is provided with the first stage in the basement and the final stage done in the exhaust fan and filter building northwest of the main building. In addition, glove boxes are equipped with small HEPA filters on their outlet providing another stage of filtration. 6 figs.

4006 (INIS-mf—11045, pp 757-776) **Mosaik casks: cask-system for conditioning, transport and storage of radioactive waste.** Rittscher, D.; Gestermann, G.; Kroth, K.; Lammertz, H. (Gesellschaft fuer Nuklearservice, Essen, Germany, F.R.; KFA, Nuclear Research Centre Julich GmbH, Julich, Federal Republic of Germany). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

With the conditioning of radioactive waste from the operations of nuclear facilities in MOSAIK casks, a way was found of safely and economically putting radioactive waste into a form fit for interim or final storage. Suitable for storage are those wastes which must be provided with shielding due to their activity or which can be consolidated with appropriate waste conditioning to high specific activities. Specifically this includes: cut-up core components, evaporator bottoms, filter auxiliaries, ion exchange resins, etc. The conditioning of a waste mixture can be particularly economical and in some cases improves the product significantly. The casks, which can be used in various types of construction, consist of a thick-walled cask body made of nodular cast iron, which is sealed leak-tight with a lid system. The wall thickness of the cask is designed according to the required shielding and, if necessary, can be reinforced with lead inserts. For use in conditioning processes, the casks are provided with the corresponding connections. MOSAIK casks can easily meet the Type B(U) specifications. The suitability of the casks for transport as well as for interim and final storage has been proved in extensive testing, such as drop tests from a maximum of 800 meters height onto a concrete foundation, fire tests with a duration of 60 minutes in a petroleum fire, long-term corrosion tests, and a measurement program lasting several years.

4007 **(LA-UR—87-3639) The development of robotics for the determination of actinide and lanthanide distribution ratios.** Nekimken, H.L.; Smith, B.F.; Peterson, E.J.; Hollen, R.M.; Erkkila, T.H.; Beugelsdijk, T.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-8710151—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001804/JAW.

From 5. international symposium on laboratory robotics; Hopkinton, MA, USA (18 Oct 1987).

A Zymate II-PyTechnology robotics system was acquired to automate solvent extraction experiments. The system is designed to make the appropriate solutions, pre-equilibrate the liquid phases, perform the desired extraction, and detect and quantitate the metal ions in each phase. The solution preparation operations include weighing the solutes on an analytical balance, adding the solvent, and mixing the resulting solution. Aqueous solution pH adjustment is automatically made by the robot. Extraction solutions are pre-equilibrated by mixing with the appropriate solutions and separating the phases. Aliquots of pre-equilibrated phases are dispensed into Teflon centrifuge tubes; the tubes are capped, mixed using a linear shaker, and centrifuged for phase separation. A sample of each phase is analyzed either manually or automatically with an on-line detection system. Advanced capabilities are under development for the robot. An IBM PC-XT is interfaced to the robot's controller so that data can be automatically obtained, tabulated, and potted, and with the use of chemometrics computer programs and expert system software, decision making on experimental design is possible.

4008 (NEI-FI—1, pp 3.2.1-3.2.12) **Methods for reliability evaluations in submarine systems.** Olofsson, A.; Borgstroem, P. (Kockums AB, Malmoe Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Nowadays a submarine system represent a very high level of complexity. This concerns engineering fields such as mechanical, electrical and computer technology. The rising complexity has lead to requirements for reliability and maintainability methods and analysis. Kockums has therfore integrated reliability engineering with system design work. A computer aided model has been developed to quantify and verify reliability, maintainability and safety in marine engineering.

4009 (NEI-FI—1, pp 8.2.1-8.2.12) **Application of safety analysis for design of large organic fine chemicals plant.** Fieandt, J. (Technical Research Centre of Finland, Espoo, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This safety research programme has two directions namely safety analyses of the process systems and safety oriented projects for design of automation and control rooms. The programme began in May 1985 accidentally six months after the worst ever happened industrial disaster - Bhopal. Known and accepted safety analysis methods and also new unproven method accomodations are applied in this design project of a large organic fine chemicals plant. The plant consists of four different integrated main processes located in two buildings. The main products are carboxin, phenmedipham and intermeidate and meta-aminophenol. In the safety research programme the two mentioned directions are integrated to constitute a safety oriented stand by project for the process design. The integration is attained by regarding the automation demands in the process safety analyses and by producing inputs for the automation and control room design.

4010 (NEI-FI—1, pp 11.1.1-11.1.14) **Useful applications of risk analysis methods in process plant design.** Salo, R. (Neste Oy, Kulloo, Finland. Environment and Safety). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Risk analysis has several good applications as design tool. Some special limitations are, however, connected with design work. These contribute considerably to the choice of methods and the ways how they can be applied. A seldom mentioned but meaningful limitation is the abstract appearance of the analysis object. While this fact gives good space for changes in design it also makes it difficult or impossible to get enough information for some types of analyses. This is why it has turned out that the use of detailed accident sequence models and their quantification only seldom give appreciable or even correct results. In addition, the use of these methodologies requires special expertise and much effort from designers. The Life Cycle Team I (founded by the Finnish Risk Analysis Group) regards hazard and operability study as well as action error analysis as methods that have proved to be useful design tools for a wide range of applications. MOND-index, explosion effects and gas cloud models and cause consequence diagram are also recommendable, mainly for major new investments with hazardous substances involved. Strictly limited quantitative reliability analyses for some of the most significant parts of technical systems can be useful, if automated analysis techniques are available.

4011 **(PB—87-225702/XAB) Mitsubishi Heavy Industries Technical Review.** (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1987. 85p. NTIS, PC E04/MF A01.

See also PB—87-187944; Color illustrations reproduced in black and white.

Table of Contents include: Development of features of LMFBR Monju (outlook), Conceptional design and some application for ISI Systems of Monju; Development of the Mitsubishi KU30-type diesel engine; Development of the TD-H series turbocharger; Development of Mitsubishi V6 engines (illustration); Development of high-speed high-performance compressor (illustration); A simulation model for the prediction of ship maneuverability; Development of Mitsubishi new-type gas holder; Development of a new high-speed electrolytic cleaning process (illustration); Development of Mitsubishi K shape screen and New products.

4012 **(PB—87-230983/XAB) Sinusoidal response of d-c SQUIDS (superconducting quantum interference devices) for r-f power measurements.** Peterson, R.L. (National Bureau of Standards, Boulder, CO (USA). Electromagnetic Technology Div.). 28 Jan 1987. 7p. NTIS, PC A04/MF A01.

Included in Jnl. of Research of the National Bureau of Standards, Vol. 92, No. 4, 253-259(Jul-Aug 1987).

Current, power, and attenuation measurements with r-f SQUIDs are based on the fact that the voltage from the microwave readout circuit can be made a nearly sinusoidal function of the magnetic flux threading the SQUID. The authors point out here that an asymmetric d-c SQUID with sufficiently low inductance can achieve a very sinusoidal output voltage with good modulation depth. The spectral purity of the sinusoid can be substantially better than that obtained with rf SQUID systems.

4013 **(PNL-SA—14627) Criticality experiments in support of nuclear material transportation systems.** Bierman, S.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 6p. (CONF-871045—10). NTIS, PC A02. Order Number DE88001907/JAW.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

A series of criticality experiments to provide benchmark type data on neutron flux traps are described and the measurement results are summarized in this paper. The experiments were designed to simulate transport and high density fuel storage facilities. The experimental assemblies consisted of 2 x 2 arrays of 4.31 wt % ^{235}U enriched UO_2 fuel rods arranged in water on a 1.891 cm square center-to-center spacing to obtain a moderator-to-fuel ratio of 1.6. Measurements were made to determine the effect that boron loading and distance between the fuel and flux trap had on the amount of fuel required for criticality. Also, measurements were made, using the pulse neutron source technique, to determine the effect of boron loading on the effective neutron multiplication constant. Data were obtained on boron loadings of 0.45, 0.36, 0.13, 0.05 and zero boron per square centimeter. In the flux trap region of two assemblies, reaction rate measurements were made using solid state track recorders to determine absolute fission rates in ^{235}U and ^{238}U. 6 refs., 3 figs., 5 tabs.

4014 **(SAND—87-2023C) An evaluation of a translator for finite element data to resistor/capacitor data for the heat diffusion equation.** (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-871207—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013926/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

This paper evaluates a translator for finite element data to resistor/capacitor data (FEM/RC) for the numerical solution of heat diffusion problems. The translator involves the derivation of thermal resistors and capacitors, implicit in the heat balance formulation of the finite difference method. It uses a finite element mesh, which consists of nodes and elements and is implicit in the Galerkin finite element method (GFEM). This hybrid translation method, FEM/RC, has been incorporated in Q/TRAN, a new Q/TRAN, HEATING-6, and a research code employing GFEM on a purely mathematical, highly nonlinear steady-state conduction benchmark problem. The evaluation concludes that the FEM/RC technique has numerical characteristics that are consistent with comparable schemes for the benchmark problem. FEM/RC also accurately translates skewed meshes. Because FEM/RC generates resistors and capacitors, it appears to offer a more computationally efficient method than the classical GFEM. 9 figs., 2 tabs.

4015 **(SAND—87-2118) Ducted propeller design and analysis.** Weir, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001925/JAW.

The theory and implementation of the design of a ducted propeller blade are presented and discussed. Straightener (anti-torque) vane design is also discussed. Comparisons are made to an existing propeller design and the results and performance of two example propeller blades are given. The inflow velocity at the propeller plane is given special attention and two dimensionless parameters independent of RPM are discussed. Errors in off-design performance are also investigated. 11 refs., 26 figs.

4016 **(SRD/HSE/R—413) A users guide to ENGULF: A computer code to model the thermal response of a tank engulfed in fire.** Ramskill, P.K. (UKAEA Safety and Reliability Directorate, Culcheth). Apr 1987. 37p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth, Warrington WA3 4NE. Order Number TI88900144/JAW.

Work performed under United States-UKAEA Fast Reactor Exchange Program.

This report provides a computer users guide to ENGULF, which is a computer code to model the thermal response of an LPG tank, partly filled with a hydrocarbon liquid when fully engulfed in fire. The users guide describes how to set up a data-file, explains the structure of the code, functions of the various subroutines, gives a variable description list, and provides an example program output. 9 refs., 5 figs.

4017 **(ST—850223) The effect of niobium on the heat-affected-zone toughness of Arctic grade line pipe (UP-S-457). Interim report.** McKay, J.C. (Stelco Technology, Hamilton, Ontario (Canada)). 23 Feb 1985. 60p. (MICROLOG—85-5791). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The effect of Nb additions on the strength and toughness of the base plate and simulated heat-affected-zone (HAZ) of a C-Mn-Mo-Ti grade 483 line pipe steel has been determined. Additions of 0.015 and 0.044 percent Nb to a base chemistry significantly increased both base plate and HAZ strength. Although the Nb additions developed a finer ferrite grain size in the controlled rolled base plate, little or no change in base plate Charpy transition temperature was found because of the offsetting effects of grain refinement and precipitation strengthening on fracture transition behaviour. Nb additions did not significantly alter the HAZ microstructure. Dilatometer measurements of the transformation behaviour confirmed that increased Nb content only slightly lowered the transformation temperatures. The HAZ toughness, measured by both CTOD and Charpy tests, deteriorated significantly with increased Nb content. The shift in Charpy and CTOD transition temperature can be quantitatively related to the increase in HAZ strength. 25 figs., 6 tabs.

4018 **Novel high-pressure isolation cell capable of reaching 120 atm mounted in an ultrahigh-vacuum chamber.** Rucker, T.G.; Franck, K.; Colomb, D.; Logan, M.A.; Somorjai, G.A. (Department of Chemistry, University of California, Berkeley and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* 58: No. 12, 2292-2294(Dec 1987). Contract AC03-76SF00098.

A high-pressure cell and manipulator mounted inside an UHV surface analysis chamber has been built which can reach 1800 psi. With this apparatus, catalytic reactions on small surface area ($\sim$1 cm^2) single crystals and polycrystalline surfaces are monitored, and the effect of reactant pressure, surface composition, and surface structure are correlated with catalytic activity. This article describes in detail the apparatus and typical experimental procedure.

4019 **(AD-A—183829/1/XAB) Superconducting-magnet system for free-electron cyclotron maser (selected portions).** Zhang, Y.; Gao, G.; Wang, Z.; Wang, S.; Qiao, X. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 12 Aug 1987. Trans. of Danzixue Tongxun (China) No. 2, 151-154(1986), by Randy Dorsey. (FTD-ID(RS)T—1058-86). 9p. NTIS, PC A02/MF A01.

The superconducting-magnet system is an important part of the free-electron cyclotron maser. In tris paper a new superconducting magnet system is designed and tested. It consists of a main superconducting magnet, a gradient superconducting magnet, a normal magnet, a cryostat, and some other accessories. The advantages of the designated magnet system are small in size, high stable magnetic field, and suitable field profile. It is very suitable for 4-mm-wave free-electron cyclotron maser.

4020 **International cooperation on the Superconducting Super Collider (SSC). Hearing before the Subcommittee on International Scientific Cooperation of the Committee on Science, Space, and Technology, US House of Representatives, One Hundredth Congress, First Session, May 7, 1987, No. 17.** Washington, DC; Government Printing Office (1987). 50p.

George J. Bradley, Jr./of DOE's International Affairs and Energy Emergencies Department was the principal witness at a hearing on the international aspects of the Superconducting Super Collider (SSC). The high cost of high energy physics research makes cooperation between international high energy physicists and their governments even more significant than in the past. The high price tag also introduces the risk of a large scientific boondoggle, which Congressional oversight will seek to avoid. Among the ideas presented were those of construction cost sharing with other countries. An appendix with questions and responses submitted for the record follows the testimony.

4021 **Metal vapor arc ion plating.** Bertram, L.A.; Fisher, R.W.; Mattox, D.M.; Zanner, F.J. (to Dept. of Energy). US Patent Application 6-906,368. 9 Sep 1986. 12p. Contract AC04-76DP00789. DE88000867 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000867/JAW.

A method and apparatus for ion plating are described. The apparatus uses more negative than a first electrode voltage in a vacuum arc remelt system to attract low energy ions from the anode electrode to the article to be plated. 2 figs.

4203 Lasers

REFER ALSO TO CITATION(S) 3812, 4132, 4146, 4169, 4170, 4171, 4642, 5210, 5261, 5290

4022 **(AD-A—183517/2/XAB) Blue-green laser diode research program. Quarterly technical progress report No. 5, 1 April-30 June 1987.** Potts, J.E.; Mar, H.A.; Walker, C.T. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). Jul 1987. 72p. NTIS, PC A04/MF A01.

The ZnSe materials work was devoted almost exclusively to various attempts at p doping, and some of the results are quite encouraging. The laboratories have tried both Na and Li doping and have completed work on Sb-doping, including some laser-assisted incorporation of Sb. Using a clean source of Na, the laboratories were able to incorporate larger concentrations of Na without a concomitant increase in unintentionally-incorporated extrinsic donors, as was the case when the Na_2Se compound source was used. Na appears to be well-behaved in the sense that the incorporated-Na concentration increases in direct proportion to the incident Na flux. However, the films remain n-type, albeit of high resistivity, even at the highest Na concentrations. In addition, the photoluminescence (PL) in high-Na-concentrations films show large broad emission near 2.60 eV, implying the presence of structural defects, perhaps induced by the Na atoms themselves. Exploring the intrinsic properties of Na as an acceptor dopant in ZnSe was studied for the first time. Previous attempts were flawed by the simultaneous incorporation of unintentially incorporated donors.

4023 **(AD-A—183871/3/XAB) Visible free-electron-laser oscillator. Final report.** Edighoffer, J.A.; Neil, G.R.; Fornaca, S.W.; Thompson, H.; Smith, T.I. (Stanford Univ., CA (USA). High-Energy Physics Lab.). Jun 1987. 50p. NTIS, PC A03/MF A01.

The first visible linac free-electron-laser (FEL) oscillator was operated above threshold at the wavelength of 526 nm with and without a taper. Peak output power of 170 kW with a macropulse average power of 1.1 watts was observed. The cavity dielectric mirrors were damaged at approximately 140 kW/cm² of average power in the presence of UV from the FEL harmonics. The gain and efficiency were much less than predicted due to developed wiggler field errors.

4024 (BNL—52090, pp 180-196) **Electron beam requirements for soft x-ray/XUV free-electron lasers.** Goldstein, J.C. (Los Alamos National Lab., NM). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

A discussion of the electron beam quality (peak current, energy spread, and transverse emittance) required to drive short wavelength free-electron lasers in the XUV (10-100 nm) and soft x-ray (<10 nm) optical wavelength ranges is presented.

4025 (BNL—52090, pp 197-213) **Storage ring lattice considerations of short wavelengths single pass free electron lasers.** Murphy, J.B. 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

To generate radiation at short wavelengths, $\lambda < 500$ A, using a free electron laser there are some stringent requirements on the electron beam. In this article the authors shall discuss these requirements and the consequences for the design of an electron storage ring to produce the required electron beam.

4026 (BNL—52090, pp 214-231) **Low emittance storage rings for free electron lasers.** Wrulich, A. (European Synchrotron Radiation Facility, Grenoble, France). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The principle emittance limitations of various storage ring structures are compared. It is then assumed that additional wigglers are introduced into the storage ring structure to reduce the damping time and the emittance. An emittance decrease can only be achieved if the wigglers are placed at positions with zero dispersion. This requirement leads to achromat structures with long dispersion free insertions to accommodate the damping wigglers, like those used for synchrotron radiation sources. Different achromat structures are discussed and the effects of wigglers on the beam dynamics are summarized.

4027 (BNL—52090, pp 232-239) **Possibility of FEL gain increase by using a double RF system.** Miyahara, Y. (Univ. of Tokyo, Japan). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Microwave instability of a bunched electron beam is discussed, and a possibility of damping the instability with a double RF system is presented. FEL gain can then be increased considerably.

4028 **(INIS-XN—68) Decree No. 472 of the Council of State on laser facilities and their surveillance.** (International Atomic Energy Agency, Vienna (Austria)). 6 Jun 1985. 5p. (In Finnish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700048/JAW.

This Decree defines the type of lasers covered by its provisions (lasers with wavelengths longer than 200 nm but less than 1 mm). It divides lasers into classes according to the degree of hazard they represent, and lays down technical safety conditions for their use and also prescribes the protective equipment required for such use. (NEA).

4029 **(PB—87-218814/XAB) optimization of field-emission electron-beam sources for high-power lasers).** Hugenschmidt, M.; Wey, J. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 30 Jun 1986. 53p. (In German). (ISL-R—117/86). NTIS, PC E04/MF E04.

Summary and illustration notes also in French.

In the study, researchers constructed and investigated large-surface field-emission beam sources. The electron current densities obtained were examined with a Faraday-Becher probe which captures the current pulses furnished by the Marx generator at the same time magneto-optically in each case. It was demonstrated that stable-discharge progress with acceleration voltages of up to 400 kV is possible with the selected construction in direct approach of the electron-beam sources with the Marx generator without interposition of a pulse-forming transfer line. Electron current densities of up to several A/sq cm were achieved for different cathode configurations with typical pulse half-widths of from 600 to 800 ns.

4030 **(PB—87-225793/XAB) CO_2 lasers for processing.** Hishii, M.; Sato, K.; Otani, A. (Mitsubishi Electric Corp., Tokyo (Japan)). 1987. 5p. (In Japanese). NTIS, PC E05/MF A01.

Included in Mitsubishi Denki Giho, Vol. 61, No. 6, 36-39(1987).

The strong demand for laser-processing systems has spurred rapid development of laser oscillators of high performance, high reliability, and small size. The article examines the laser pulse and beam-mode characteristics that greatly influence laser-processing performance. The discussion broadens, taking up technical trends in laser-oscillator design, features of Mitsubishi lasers, construction requirements, and an overview of future lasers.

4031 **(SAND—87-2202C) Narrow linewidth gain measurements in a KrF excimer amplifier pumped longitudinally by a high-power electron beam.** Adams, R.G.; Dillon, M.M.; Gerber, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-8709146—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001365/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Single-pulse gain measurements have been performed on an excimer amplifier pumped longitudinally by a high-power (~4 MW/cm²) electron beam. This amplifier maintained the narrow linewidth (<10 GHz) characteristic of the probe laser beam produced by a grating-tuned, discharge excimer laser. Gain was measured at 248.45 nm, the center of the KrF laser gain profile, over four orders of magnitude of input intensity for a laser pulse of 20-ns FWHM. The data an be represented by the Rigrod-Rice steady state analysis and yield values over this data range for the small signal gain, the nonsaturable absorption, and saturation intensity of

g_0 = 12.6%/cm, $\alpha \sim$ 0.45%/cm, and I/sub s/ = 4.1 MW/cm², respectively, for a 750 torr laser mix. 4 refs.

4032 **(UCID—21226) An empirical model for predicting the absolute radiative emission and absorption spectra of xenon flashlamps.** Jancaitis, K.S.; Powell, H.T. (Lawrence Livermore National Lab., CA (USA)). 22 Oct 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002247/JAW.

We have developed an updated quasi-stationary model for radiative properties of xenon flashlamps which adequately describes all of the experimental data (approximately 75 spectra) obtained for preionized lamps operated at a pulsewidth greater than 300 μs. The form of this model is such that it may be easily used to predict both the single-pass pumping and heating of solid-state laser media. To this end, we have implemented the lamp model in a menu-driven program (described in the appendix) for IBM-compatible microcomputers which predicts both the instantaneous and time-averaged output of the flashlamp as well as the interaction of the lamp radiation with an arbitrary laser medium. Calculations performed using the spectra from this model agree quite well (i.e., a maximum deviation of between 10 and 15%) with those obtained using experimentally measured spectra. 10 refs., 5 figs., 1 tab.

4033 **Demonstration of soft x-ray amplification in nickel-like ions.** MacGowan, B.J.; Maxon, S.; Hagelstein, P.L.; Keane, C.J.; London, R.A.; Matthews, D.L.; Rosen, M.D.; Scofield, J.H.; Whelan, D.A. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* 59: No. 19, 2157-2160(9 Nov 1987). Contract W-7405-ENG-48.

We report the first observation of amplification of spontaneous emission at soft x-ray wavelengths by ions in the nickel-like sequence. The ions are created by high-intensity laser irradiation of a thin foil. Gains of order 1 cm/sup -1/ are observed on J = 0-1, 4d-4p transitions in Eu/sup 35+/ at 65.83 and 71.00 A. There is some evidence for amplification on the analogous lines at 50.26 and 56.09 A in Yb/sup 42+/. The pumping mechanism is believed to be electron collisional excitation from the ground state. The scheme should be readily scalable to produce amplification in W/sup 46+/ at 43.15 A.

4034 **Continuous-wave 25-W Nd^{3+}:glass fiber bundle laser.** Zapata, L.E. (Miami University, Oxford, Ohio 45056). *Journal of Applied Physics;* 62: No. 8, 3110-3115(15 Oct 1987).

For the first time, we have achieved continuous, moderate power operation of a Nd^{3+}:glass fiber bundle laser. The fiber bundle laser consisted of 1450 fibers, each 100 μm in diameter, with 75-μm core phosphate laser glass doped at 8 wt. % Nd_2O_3. In separate experiments, the laser fiber bundle was energized by either a pulsed xenon flashlamp or a continuous-wave argon arc lamp. A maximum energy of 0.8 J at 4.9-kW peak power was obtained in the pulsed flashlamp experiments whereas a maximum cw power of 25 W was obtained with the arc lamp. Neither the pulsed nor the cw systems were optimized. The beam profile was imaged with low spatial resolution and was found to be lobed. In both experiments, the output was characterized and fitted to a first-order kinetic model. The loss coefficient of 0.00 266 cm^{-1} was inferred from the model and was found to be 30% higher than measured in the bulk laser material.

4035 **Compact, efficient, solid-state flashlamp modulator.** Matilaine, J.L.; Crewson, W.F.J. (Universal Voltronics Corp., Mt. Kisco, NY). pp 26-32 of Pulse power for lasers. Burkes, T.R. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The Universal Voltronics type BAX-1.6-15,000-RC-LANL flashlamp modulator built for Los Alamos National Laboratories in 1984 has proved a highly reliable unit. It has delivered over 1000 hours of failure-free service. This unit develops 15 kW average output power: it contains two separate PFN subsystems, each with 30 microfarad capacitance, charged ot 1414 volts, which deliver 1000-ampere pulses to two flashlamp loads at 250Hz. The efficiency of the unit is in the 90-percent range. About one kW is dissipated inside the modulator. The entire modulator is packaged in a 4 ft. long, 2 ft. high, 2 ft. wide enclosure, and is water cooled. It consists of solid-state controls (shot counters, digital voltmeters, LED indicators), and SCR-regulated DC supply with water-cooled transformer, an SCR command charger and water-cooled resonant charging choke, and two PFN assemblies, each containing a 30-microfarad capacitor, an 1800-volt inverter-class SCR output switch, a pulse shaping inductor and a "simmer" supply to sustain the flashlamp discharge between pulses. Each PFN is mounted on a removable tray for easy service and maintenance.

4036 **Advances in Laser Science-II.** Lapp, M.; Stwalley, W.C.; Kenney-Wallace, G.A.; Lerner, R.G. (eds.). New York, NY; American Institute of Physics (1987). 758p. (CONF-861038—). American Institute of Phyics, 335 East 45th St., New York, NY 10017. Order Number TI88001386/JAW. Contract W-7405-ENG-48.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The meeting covered topics on the latest advances in laser technology and applications. The general categories are as follows: advanced lasers and coherent sources; nonlinear optical phenomena and applications; atomic, molecular and ionic spectroscopy; condensed matter, surface and particle spectroscopy; laser photochemistry and photophysics; diagnostic and analytical applications of lasers; and laser research and techniques in medicine and biology. (LSP)

4037 **Practical laser safety.** Winburn, D.C. NY; Marcel Dekker (1985). 173p. Marcel Dekker Inc., 270 Madison Ave., New York, NY 10016.

This book includes discussions of the following topics: characteristics of lasers; eye components; skin damage thresholds; classification of lasers by ANSI Z136.1; selecting laser-protective eyewear; hazards associated with lasers; and, an index.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 2966, 3399, 3426, 3437, 3507, 4014, 5218

4038 **(AERE-R—12561) Steady state heat transfer measurements relevant to reactor reflood conditions. Part 1. Upflow.** Costigan, G.; Ralph, J.C.; Wade, C.D. (UKAEA Atomic Energy Research Establishment, Harwell. Thermal Hydraulics Div.). Feb 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750650/JAW.

Steady state, post dryout heat transfer measurements obtained using the "hot-patch" experimental technique are described. The data cover an equilibrium quality range of -2% to 40%. The parametric trends are qualitatively explained using a post dryout flow pattern description, based on observations made using dynamic neutron radiography. The relative magnitudes of axial conduction and precursory cooling are a consequence of the hydrodynamics in the quench front region. Methods by which the post dryout heat transfer predictions of codes such as TRAC may be improved are suggested, but the precise form of these changes awaits the completion of void fraction and steam temperature measurements, which are to be performed shortly.

4039 **(BCU/CE—8503) Pre-heating of wood chips by simulated kraft recovery boiler flue gases. Final report.** Watkinson, A.P.; Chow, B. (British Columbia Univ., Vancouver (Canada). Dept. of Chemical Engineering). Mar 1985. 58p. (MICROLOG—85-4577). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Heat transfer rates from gases to wood-chips were measured by an unsteady state technique. Hot air and air/steam mixtures at about 130/sup 0/C were passed upwards through packed beds of Douglas fir wood chips which had previously been screened for size. Temperatures were measured in the gas phase as a function of time and position, and heat transfer coefficients from the gas to the solids determined using a mathematical model. The model was de-

veloped assuming plug flow of gas through a packed bed of slab-shaped particles with finite internal thermal resistance. The effects of gas velocity, wood-chip thickness, and presence of steam on the heat transfer coefficients were determined. In some experiments internal wood-chip temperatures were also measured. Pressure drop data were taken over a range of air velocities at room temperature. Heat transfer and pressure drop data are compared with information on irregularly-shaped particles in the literature, and some recommendations made for use in design of chip pre-heating equipment. 22 figs., 3 tabs.

4040 **(CEA-N—2525) Turbulence model in mixtures. First part: Statistical description of mixture.** Besnard, D. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Mar 1987. 29p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750453/JAW.

Classical theory of mixtures gives a model for molecular mixtures. This kind of model is based on a small gradient approximation for concentration, temperature, and pression. We present here a mixture model, allowing for large gradients in the flow. We also show that, with a local balance assumption between material diffusion and flow gradients evolution, we obtain a model similar to those mentioned above.

4041 **(CEA-N—2526) Turbulence model in mixtures. Second part: turbulence transport and setting of mixtures.** Besnard, D.; Harlow, F.H. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Mar 1987. 55p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750454/JAW.

In this report, we present a turbulence model for mixtures, allowing for the description of instability induced turbulence creation. We specialize this model to Rayleigh-Taylor instability induced turbulence, and study the associated numerics. We finally simulate a shock tube experiment exhibiting the turbulent mixing of two gases.

4042 **(CEA-N—2527) Creation of turbulence owing to inhomogeneities in a flow. Application to turbulence models.** Besnard, D.; Cheneau, J. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Mar 1987. 55p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750455/JAW.

We describe in this paper a mechanism for the creation for instabilities, which may evolve into turbulence, based on microscopic properties of the fluid which is considered. We also investigate implications of this theory on k-ε models.

4043 **(CNEA-NT—33/85) Data bank of critical heat flux. Brief parametric study of the critical heat flux.** Balino, J.L.; Ruival, M.H. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). 1985. 60p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700013/JAW.

More than 13,000 measurements of critical heat flux are classified in a data bank. From each experiment the following information can be obtained: cooling medium (light water, freon 12 or freon 21), geometry of the test section and thermalhydraulic parameters. The data management is performed by a computer program called CHFTRAT. A brief study of the influence of different parameters in the critical heat flux is presented, as an example of how to use the program. (M.E.L.).

4044 **(DOE/ER/72012—T5) Numerical analysis, computing and fundamental studies in fluid mechanics: Summary report No. 12, April 1, 1986-March 31, 1987.** (California Inst. of Tech., Pasadena (USA). Firestone Lab.). 1987. Contract AS03-76ER72012. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001912/JAW.

This report describes work completed and work in progress on the following topics: Vortex dynamics and vortical flows; Hele-Shaw fingering at small values of surface tension; Numerical methods for stiff differential equations; Pattern formation in solidifying systems; Path instability in rising bubbles; and Multigrid solvers for partial differential equations. (FI)

4045 **(EPRI-RP—8006-8) International workshop on two-phase flow fundamentals.** Wood, R.T. (ed.). (Rensselaer Polytechnic Inst., Troy, NY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. Contract FG02-86ER13637. 225p. (CONF-870320—). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001478/JAW.

From Department of Energy international workshop on two-phase flow fundamentals; Troy, NY, USA (16 Mar 1987).

The primary objectives of this Workshop were to assess the current capabilities to predict two-phase flow and heat transfer phenomena and to reach a consensus on the future research directions and priorities necessary to advance the state-of-the-art. The results of an extensive Physical and Numerical Benchmark Exercise were presented at the Workshop held at Rensselaer Polytechnic Institute (RPI). It was shown that, while numerical methods exist with which to evaluate both one-dimensional and multidimensional two-phase flows, current generation analytical models were often inadequate. In particular, it was demonstrated that no preferred general closure laws exist for two-fluid models of two-phase flow. Several invited lectures were given which summarized the state-of-the-art in two fluid modeling, numerical methods and two-phase instrumentation and experimental techniques. These talks stressed that there is considerable uncertainty in our ability to model interfacial transfers and that the instrumentation needed for the measurement of many key parameters often does not exist. In anticipation of the need to further assess two fluid models of two-phase flow various new benchmark data sets were discussed and selected. Significantly, some of these data sets highlight multidimensional aspects of two-phase flow, while in others nonequilibrium phenomena are significant. The Workshop was evaluated by a distinguished panel that comprised an Evaluation Committee. Their report is given in this report.

4046 **(FEI—1764) Numerical investigation of characteristics of vapor-droplet flow under nonuniform heat release along the tube length.** Kashcheev, V.M.; Muranov, Yu.V.; Yur'ev, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700329/JAW.

Numerical study of the effect of non-uniform energy release of the type "hot", "cold" spot in a vertical heated tube on mass-heat-exchange characteristics of vapour-drop non-equilibrium flow is carried out. The calculations are conducted for P=15.6 MPa pressure, rhow=(500-2000) kg/m/sup 2/s mass rates and for different values of power supplied to the channel. The calculated values are compared with experimental data. 7 refs.; 9 figs.

4047 **(FRCEA-TH—23) Experimental qualification of the calculation methods of fluid-structure interactions in the tube circuits of nuclear reactors.** Pedroso, L.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1986. 205p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750236/JAW.

This work concerns the theoretical and experimental study of the propagation and damping of pressure waves (pressure losses), generated by an unsteady flow (sinusoidally oscillating flow) passing through singularities (constructions having orifices with square edges) placed in ducts. After a systematic review of state-of-the-art of losses in unsteady flows, a preliminary study of the behavior of a variable-pressure source, generated by the vibrating plate, in a fluid was completed. In order to perform the experimental measurements we have realized and exploited a specifically designed apparatus, consisting of a piston, driven by a vibrator, which interacts with a fluid in a horizontal tube. In the test section of the flow circuit, the singularity was introduced by interposing perforated plates, of variable geometry, in the tube. The pressure profiles are measured along the tube. A mathematical model, based on the hydrodynamic equations has been developed to interpret the experimental observations. This study has shown that the pressure drop between the two sides of the singularity can be accounted for. The period parameter

was varied from about 0.2 to 23, the Reynolds number from 5 x 10/ sup 2/ to 1.2 x 10/sup 5/, and the section porosity (orifice/pipe area ratio) from 0.05 to 0.5. We have not found any evident correlation between the pressure loss coefficient and Reynolds number. For high values of the period parameter, the pressure loss coefficient approaches its predicted value by the steady flow; in the low values, a wide scatter of measured pressure loss coefficient was found to be consistently greater than those resulting in the steady flow case.

4048 **(FRCEA-TH—30) Study of the distributions of flow rate and enthalpy in the sub-channels of a bundle geometry of nuclear reactors in one and two-phase flow.** Bayoumi, M.A.A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Institut National Polytechnique, 38 - Grenoble (France)). Oct 1976. 191p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753225/JAW.

A bibliographic study shows that the experimental studies examined, have been developed to understand the phenomenon acting on the mixing between the sub-channels of which geometries are such these of rod bundles used in some nuclear reactors. Experimental devices and tests have been developed to study the influence of the following parameters, operating conditions, pressure, flow rate, power brought to the bundle and inlet temperature on the distribution of flow rates and vapor content among the different sub-channels. By means of non isokinetic sampling, one has determined the enthalpy of the fluid participating to the mixing between the communicating sub-channels and it has been shown that the value of this enthalpy depends strongly on the type of fluid flow and that this enthalpy cannot be either the enthalpy of one of the two sub-channels, nor (always) an average of these two enthalpies. The experimental results have been compared with calculations developed with the code FLICA, concerning the mass velocity distribution, the exchange term of linear momentum, and the variation of the transversal enthalpy with regard to the type of fluid flow. A study of local void ratio measurement, by means of optical probes, has been proposed. The present study has been carried out with a smooth geometry.

4049 **(FRNC-TH—2361) Exergetical analysis of combustion, heat transfers, thermodynamical cycles and their applications.** Buchet, E. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Nov 1983. 186p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750107/JAW.

Exergetic analysis allowed to show up and evaluate irreversibilities in combustion, vapor exchanges and thermodynamic cycles, and also to justify processes often used to improve yields of thermal and energetic plants, and among them some more and more complex in cogeneration plants. This analysic method has been applied to thermal or nuclear steam power plant, to gas turbines and to cogeneration.

4050 **(GKSS—87/E/12) Two-phase flow and pressure drop in T-junctions with horizontal run and vertical branch. Final report.** Katsaounis, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750178/JAW.

Visual observations of single- and two-phase dividing flow and pressure drop measurements were performed in T-junctions with horizontal run and vertical branch. Both tees used were geometrically similar, in a scale of 1:4. The measurements were performed for plug/slug and stratified flow pattern regime in horizontal tube. Based on the single-phase form-resistance pressure drop correlation of Gardel a corresponded calculation model was developed for the two-phase flow verified by the own measurements. With 38 figs., 6 tabs.

4051 **(INIS-mf—10966) Influence of the friction coefficients, the power and the flowrate on the two-phase flow instabilities in natural circulation.** Kerris, A.M. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Apr 1987. 124p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700036/JAW.

A study of non-linear effects of a two phases flow instabilities has been done using theoretical and experimental models. The experimental model is based on a boiling channel placed in a water loop of natural convection. Studies of stability, with introduction of fluctuations over different parameters, have been achieved using the two models. The results of the experimental model agree with those of the theoretical model. It was found that the head loss coefficients K/sub I/ and K/sub E/ of the inlet and outlet channel respectively, had an influence over the stability of the system. An increase in the former produces an increase in the stability while an increase in the latter has the effect of increasing the instability. In the experiment, oscillations of the flow rate were observed. Two types of oscillations were noticed: (1) small oscillations called pressure drop oscillations, (2) large oscillations called density wave oscillations. A study of the variation of these two types of oscillations with power and the coefficient K/sub I/ and K/sub E/ had been achieved. It was found that pressure drop oscillations disappeared with the increase of power and the density waves oscillations increased with the increase of power.

4052 **(KFK—4212) Rayleigh-Benard convection in a Hele-Shaw cell - a numerical study.** Guenther, C.; Mueller, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). May 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750175/JAW.

Free convection in narrow vertical gaps heated from below gives rise to several different flow patterns as has been demonstrated by previous experimental investigations. A numerical study is presented aimed at simulating the observed flow phenomena in Hele-Shaw cells of small lateral extend. The numerical study is based on the assumption that the flow is essentially two-dimensional. This allows an approach using a one-term Galerkin approximation with respect to the direction perpendicular to the gap and a finite difference scheme with regard to the coordinates in the plane of the gap. The calculations result in realistic values of the critical Rayleigh numbers for the onset of steady and oscillatory convection. Most of the observed unsteady flow patterns can be simulated numerically. It is shown that five different stable flow patterns can occur at one particular Rayleigh number. The different stable flow patterns are coupled by a variety of complex transitions. Moreover the calculations show that a realistic description of the observed flow phenomena can not be obtained by a simplified model using the Darcy law in the momentum equation and implying slip flow at the small confining boundaries.

4053 **(KFK—4252) Interaction of local instabilities during oscillatory convection.** Koster, J.N. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jul 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750438/JAW.

This paper studies the time dependent convective flows in Hele-Shaw slots which are heated from below. In this experimental study, the evolution of oscillatory phenomena is traced through the time dependent regime which is bounded on either side by regions of steady flow. The history of thermal events is recorded by thermocouples which protrude into the test fluid (silicon oil, Pr $\simeq$ 37) at the four corners of the cavity. Flow patterns are visualized by holographic interferometry and temperature signals are analyzed using Fourier transforms and correlation functions. The results of this investigation show that the richness of the dynamic behavior of time dependent convective flows in high Prandtl number fluids is determined by the interaction of individual, spatially distributed instability events. Additionally, this behavior is dependent on the symmetry of the flow pattern which governs phase-locking properties of thermal plumes developing at different locations.

4054 **(OEFZS—4400) Dynamics of heat transfer at a turbulent pipe flow. Part 4 .** Schmidl, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1987. 95p. (In German). (RS—291/87). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700065/JAW.

The temperature distribution of a turbulent pipe flow will be described at a system of differential equations. With changing several paramenters these equations are solved.

4055 **(OH/R—86/329/K) Flow distribution and tube vibration in heat exchangers.** Anderson, H.L. (Ontario Hydro, Toronto (Canada). Mechanical Research Dept.). 20 Jan 1987. 101p. (MICROLOG—87-04198). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report was carried out under the auspices of the Canadian Electrical Association to study flow distribution and tube vibration in heat exchangers. An experimental program was carried out on a full-size heat exchanger in four test phases of parametric study. The flow induced vibration data were used to quantify and develop non-intrusive vibration monitoring techniques for online problem evaluation and to study the influence of design features and conditions on the vibration. The results proved the effectiveness of the monitoring techniques and point the way for future development of long-term monitoring for predictive maintenance. The data have provided new insights for the design and operation of heat exchangers with respect to vibration. 55 figs., 4 tabs.

4056 **(UCRL—96055) Dusty gas compressible turbulent boundary layers: Dusty surface reaction influences on heat transfer.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 12p. (CONF-871207—5). NTIS, PC A02. Order Number DE87010812/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Results of theoretical studies on the erosive influences of dilute concentrations of solid aerosol dispersants are discussed. The boundary layer flows studied are turbulent and compressible. Numerical procedures for boundary layer simulations have been applied. The procedures include consideration of concomitant influences of dispersed non-colliding particles in the large interphase velocity slip limit. These flow situations are encountered in supersonic jet combustion, solid fuel propellant bed combustion in projectile launchers, solid rocket nozzle flows, and high speed combustion flow near surfaces. Special consideration is given here to chemically reactive turbulent flows in which an entrained dispersed phase may be beneficial in reducing solid boundary surface heating and erosion. Additive particle entrainment, tangential surface slip or momentum persistence of the flows, and collisions between impinging and reflected aerosols cumulatively increase their concentration in the immediate vicinity of a solid surface. This enhancement of the near-surface aerosol concentration appears to retard gas/surface corrosive reactions by altering both the turbulent energy distribution and the average flow structure so as to reduce the intensity of near-wall turbulent transport. In the present work, statistical flow simulations, two-phase flow experiments, and detailed boundary layer model calculations are used to help illustrate these processes. 18 refs., 15 figs.

4205 Materials Testing

REFER ALSO TO CITATION(S) 3296, 3297, 3298, 3299, 3300, 3301, 3302, 3303, 3304, 3305, 3306, 3307, 3308, 3309, 3310, 3311, 3312, 3313, 3314, 3316, 3317, 3318, 3319, 3320, 3321, 3322, 3323, 3324, 3325, 3326, 3327, 3328, 3329, 3330, 3331, 3332, 3333, 3334, 3335, 3336, 3337, 3338, 3339, 3340, 3341, 3342, 3343, 3374, 3442, 3443, 3695, 3700, 3758, 4018

4057 **(CNEA-NT—14/82) Study of friction and axial effects in pellet-clad mechanical interaction.** Harriague, S.; Mayer, J.E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1982. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700008/JAW.

An analysis is made of the effect of friction and axial forces along the fuel rod in the pellet-cladding mechanical interaction in a commercial reactor under a power-up ramp. The effect of different pellet and rod shapes on their behaviour was also determined. A linear thermoelastic computer program was used in order to obtain the stiffness matrix of a compound structure from the stiffness of its components. Pellet-cladding displacements, localized deformations of the cladding in the interfaces between pellets, as well as pellet and cladding axial deformations were determined for different power axial profiles as well as for pellets with and without dishing and with height/diameter ratios of 1.7, 1 and 0.5. (M.E.L.).

4058 **(EGG-M—08987) Acoustic emissions at an open crack.** Johnson, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 11p. (CONF-870691—5). NTIS, PC A02. Order Number DE88001504/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

Both finite difference and finite element techniques have been shown to be capable of modeling the propagation of acoustic emissions (AE) from a simple source to any close point in the part. However, the calculations done to date could also be done using the simpler Green's function methods. In this work the capabilities of the numerical methods are used to model problems that include the complexities that cannot be handled using the Green's function methods. In particular, the effect of the presence of the macrocrack on the received signal is investigated. We assume that the macrocrack interacts only as a geometric structure from which sound may reflect and mode convert, thereby complicating the signal at the receiving transducer. Numerical calculations of the AE field due to an open crack are compared to the Green's function results in a solid with no flaw. 7 refs.

4059 **(FhG-IzfP—860125-TW) Steady reconstruction process - development, testing and comparison in ultrasonic testing.** Langenberg, K.J.; Schmitz, V. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Kassel Univ. (Gesamthochschule) (Germany, F.R.)). 30 Jun 1986. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750183/JAW.

The fault parameters can be extracted from a few data of high quality in steady test procedures. The boundary conditions for the successful use of such a process were researched and found, so that by using theoretical models for the elasto-dynamic interaction of fault and ultrasonics, a concentration of wavefronts instead of resonances and a wide band careful collection of data makes a physical interpretation in the form of specific geometry torques possible. Models of the interaction of ultrasonics and faults for two fault geometries (cracks and pores) were developed which permit the calculation of A scans of any bandwidth and with any angle of scatter for the direct and mode converted parts of the elastic ultrasonic scatter wave. The curved pressure and shear waves including the mode converted bending fields over an angular range of 360deg were experimentally recorded. Their agreement including the additional wavefronts caused by the close field of the crack bending field is close. Classification of torques is done on two examples (crack, cylinder) for evaluation purposes. It was found that a classification was possible according to the sign of the a/sub 1/ polynomial coefficient.

4060 **(INIS-XN—69) Decree No. 85-968 of 27 August 1986 amending Article R.233-83 of the Labour Code and defining the health and safety conditions to be met by gamma industrial radiography equipment.** (International Atomic Energy Agency, Vienna (Austria)). 14 Sep 1986. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700049/JAW.

Published in Journal Officiel de la Republique francaise.

This Decree, amending Article R 233-83 of the Labour Code, applies to gamma-ray industrial radiography equipment whether mobile or fixed. It contains specific technical conditions concerning the equipment, in particular, safety devices located at the entry and exit points of the source's shield. The equipment must

carry a notice mentioning"Radioactive"prepared by the constructor or the importer of the source, which explains the conditions for handling, setting-up, use and maintenance of the source, including the frequency of revisions. The Decree entered into force on 1 June 1986. (NEA).

4061 **(ND-R—1427(R)) Final report on the performance achieved by non-destructive testing of defective butt welds in 50mm thick Type 316 stainless steel.** Ford, J.; Hudgell, R.J. (UKAEA Risley Nuclear Power Development Establishment). Mar 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750125/JAW.

This report concludes a programme of work started approximately eight years ago to fabricate deliberately defective austenitic downhand welds in 50 mm thick Type 316 plate and then to examine them non-destructively under ideal laboratory conditions. After completing and reporting the Non-Destructive Testing (NDT), the specimens were subjected to detailed metallography to locate, identify and size all the planned and unplanned flaws in the welds. The report gives the final analysis of this exercise on the relative merits of X-radiography, pulse echo ultrasonics and the time-of-flight technique for the detection, location and sizing of weld flaws. It was found that X-radiography and pulse echo ultrasonics were the best techniques for flaw detection but neither technique was reliable for flaw sizing. The time-of-flight technique provided accurate sizing data but the location of the flaws had to be known to identify the diffracted signals from the extremities of the flaws due to the poor signal to noise ratio. Observations are also reported on the fabrication of deliberately defective austenitic welds for use as reference specimens in the FR programme.

4062 **(SKI—84113) Ultrasonic detection and sizing of cracks in cast stainless steel samples. Round Robin Test - Screening Phase.** Allidi, F.; Edelmann, X.; Phister, O.; Hoegberg, K.; Pers-Anderson, E.B. (Swedish Nuclear Power Inspectorate, Stockholm; Swedish Plant Inspectorate, Stockholm). 20 May 1986. 161p. (SA-FOU—86-04). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753369/JAW.

The test consisted of 15 samples of cast stainless steel, each with a weld. Some of the specimens were provided with artificially made thermal fatique cracks. The inspection was performed with the P-scan method. The investigations showed an improvement of recognizability relative to earlier investigations. One probe, the dual type, longitudinal wave 45 degrees, low frequence 0.5-1 MHz gives the best results. (G.B.).

4063 **Application of real-time 3-D SAFT in the tandem mode.** Doctor, S.R.; Hall, T.E.; Reid, L.D.; Mart, G.A. (Battelle Pacific Northwest Labs., Richland, WA). *Nuclear Engineering and Design;* **102**: No. 3, 387-396(Jul 1987). (CONF-8610283—). Contract AC06-76RL01830.

From 12. MPA seminar on safety and reliability of pressure components with special emphasis on nuclear technology; Stuttgart, F.R. Germany (9 Oct 1986).

This paper presents a description of what tandem SAFT is as contrasted with pulse-echo SAFT. The implementation of tandem SAFT is far more complicated than pulse-echo SAFT and puts greater demands on computer processing speed and/or virtual computer memory capacity. Tandem SAFT has been implemented by using look-up tables for determining path lengths so that no computations are needed during processing. Furthermore, the tandem SAFT has been developed for operation on a special-purpose parallel processor so that speeds of 10 A-scans/s can be achieved. A series of studies have been made of system performance showing resolution performance, effects of saturation on imaging, defect orientation effects, sizing criteria, and difficulties encountered on thin specimens when using tandem SAFT.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 3248, 4159, 4264

4064 **(AD-A—183877/0/XAB) Bayesian failure probability model sensitivity study. Final report.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 30 May 1986. 70p. NTIS, PC A04/MF A01.

The Office of the Manager, National Communications System (OMNCS) has developed a system-level approach for estimating the effects of High-Altitude Electromagnetic Pulse (HEMP) on the connectivity of telecommunications networks. This approach incorporates a Bayesian statistical model which estimates the HEMP-induced failure probabilities of telecommunications switches and transmission facilities. The purpose of this analysis is to address the sensitivity of the Bayesian model. This is done by systematically varying two model input parameters--the number of observations, and the equipment failure rates. Throughout the study, a non-informative prior distribution is used. The sensitivity of the Bayesian model to the noninformative prior distribution is investigated from a theoretical mathematical perspective.

4065 **(UCRL—96518) Streak camera dynamic range optimization.** Wiedwald, J.D.; Lerche, R.A. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 8p. (CONF-8708110—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001632/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The LLNL optical streak camera is used by the Laser Fusion Program in a wide range of applications. Many of these applications require a large recorded dynamic range. Recent work has focused on maximizing the dynamic range of the streak camera recording system. For our streak cameras, image intensifier saturation limits the upper end of the dynamic range. We have developed procedures to set the image intensifier gain such that the system dynamic range is maximized. Specifically, the gain is set such that a single streak tube photoelectron is recorded with an exposure of about five times the recording system noise. This ensures detection of single photoelectrons, while not consuming intensifier or recording system dynamic range through excessive intensifier gain. The optimum intensifier gain has been determined for two types of film and for a lens-coupled CCD camera. We have determined that by recording the streak camera image with a CCD camera, the system is shot-noise limited up to the onset of image intensifier nonlinearity. When recording on film, the film determines the noise at high exposure levels. There is discussion of the effects of slit width and image intensifier saturation on dynamic range. 8 refs.

4066 **(UCRL—96519) Resolution limitations and optimization of the LLNL streak camera focus.** Lerche, R.A.; Griffith, R.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 11p. (CONF-8708110—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001633/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The RCA C73435 image tube is biased at voltages far from its original design in the LLNL ultrafast (10 ps) streak camera. Its output resolution at streak camera operating potentials has been measured as a function of input slit width, incident-light wavelength, and focus-grid voltage. The temporal resolution is insensitive to focus-grid voltage for a narrow (100 μm) input slit, but is very sensitive to focus-grid voltage for a wide (2 mm) input slit. At the optimum wide-slit focus voltage, temporal resolution is insensitive to slit width. Spatial resolution is nearly independent of focus-grid voltage for values that give good temporal resolution. Both temporal and spatial resolution depend on the incident-light wavelength. Data for 1.06-μm light show significantly better focusing than for 0.53-μm light. Streak camera operation is simulated with a computer program that calculates photoelectron trajectories. Electron ray tracing describes all of the observed effects of slit width,

incident-light wavelength, and focus-grid voltage on output resolution. 7 refs.

4067 **Radio frequency coaxial feedthrough device.** Owens, T.L.; Baity, F.W.; Hoffman, D.J.; Whealton, J.H. (to Dept. of Energy, Washington, DC). US Patent 4,694,264. 15 Mar 1987. Filed date 5 Mar 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A high voltage radio frequency coaxial feedthrough device is described for transmitting high voltage radio frequency energy between first and second coaxial transmission lines of different dielectric mediums and pressures. The device consists of: a tapered inner coaxial conductor including means for electrical connection at an upstream end thereof to an inner coaxial conductor of the first coaxial line and at a downstream end thereof to an inner coaxial conductor of the second coaxial line; a tapered outer coaxial conductor including means for electrical connection at the upstream end thereof to an outer coaxial conductor of the first coaxial line at the downstream end thereof to an outer coaxial conductor of the second coaxial line; a coaxially disposed cylindrical insulator formed of a rigid, impermeable, electrically insulating material; means for removably connecting the cylindrical insulator in a leak-tight sealing arrangement between the first mounting ring of the cylindrical insulator and the inner conductor at the upstream end of the cylindrical insulator.

4068 **A very low bandwidth, unattended imager for surveillance applications.** Eichel, P.H.; Jakowatz, C.U. Jr. (Sandia National Labs., Albuquerque, NM 87185). pp 244-249 of Applications of digital image processing IX. Tescher, A.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The need arises in certain vehicular surveillance applications for an electronic imager that can perform without human interaction and can transmit definitive images over very low bandwidth channels. The investigators have found that line scan imagers offer particular advantages towards these ends. Specifically, the use of a line scan imager facilitates the following processing steps: 1) Segmentation of the vehicle from the background, 2) Automatic exposure control, 3) Light level equalization prior to quantization, and 4) Implementation of an adaptive sampling scheme. These processing steps together with the source encoder may be implemented on a relatively low throughput processor and achieve near real time operation. The specific encoding method used here is an extended differential pulse code modulation (DPCM). A prototype system has been developed, producing medium resolution images at less than 10K bits per frame.

4209 Waste Processing Plants And Equipment

4069 **(AFLW/PL—8606) Oil and gas drilling waste management consideration by Public Lands Division staff, Department of Forestry, Lands and Wildlife in Alberta.** Lloyd, D.A. (Alberta Dept. of Forestry, Lands and Wildlife, Edmonton (Canada). Public Lands Div.). 1986. 30p. Alberta Dept. of Forestry, Lands and Wildlife, Information Centre, Alberta Energy, Main floor, Bramalea Bldg., 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This paper was presented at the 11th Annual Canadian Land Reclamation Conference, Vancouver, British Columbia, June 3-6, 1986. Drilling fluid disposal guidelines were developed to provide some control over fluid disposal operations. Public Lands Division assumed management control of these guidelines in September 1983. Because the drilling wastes are toxic and not much is known about how to properly dispose of the fluids and solids, several steps were taken to help resolve the complex drilling waste disposal problem. Sump contents were analysed using standard soil analysis procedures. Some major detrimental components evidenced were high sodium, high chlorides, high pH, and high potassium. Common soil parameters were then noted to help discern disposal options. Burial and deep trenching are being discouraged on open rangeland or agricultural soils. Proper berming of wellsites is being stressed. Surface disposal through on or off lease disposal of treated fluids (where required) and land spreading the solid portion is now encouraged where land is suitable. A consultant was hired to provide an interim disposal manual for use by government field staff. Ongoing site evaluations and field trials should help lead to more suitable and environmentally acceptable drilling waste disposal practices on public lands in Alberta.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 3292, 3617

4070 **(AERE-R—12675) Comparison of the visibility and phase particle sizing techniques and their application to fuel sprays.** Lightfoot, N.S.; Negus, C.R. (UKAEA Atomic Energy Research Establishment, Harwell. Engineering Sciences Div.). May 1987. 23p. (CONF-8607347—). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

From LDA conference; Lisbon, Portugal (1 Jul 1986).

Two extensions to the Laser Doppler technique were employed to measure the size of spray droplets. These methods employ the visibility of the signal or the phase difference between the signals from two detectors. The calibration of each particle sizing technique was tested using monodispersed droplets before being employed to measure the size of Kerosene droplets in the spray of Harwell's 30 kW model furnace. Comparison of the two techniques showed the phase method to give the more consistent results and this was then used to find the interrelation between droplet velocity and size.

4071 **(BMFT-FB-T—86-183) Ceramic domestic water heater for gas and liquid fuel. Final report.** Huber, J.; Schelter, H.; Foerster, S.; Quell, P.; Pitt, R.; Bothien, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Hoechst CeramTec A.G., Selb (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.)). Dec 1986. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750001/JAW.

The aim of this project was the development of a ceramic domestic water heater completely made out of ceramics. The combustion gas passes only ceramic components from the beginning of combustion up to the entrance into the exhaust pipe. The combustion gas is cooled down below the dewpoint and the flue gas temperature is very close to the temperature of the recirculated heating water. The heating power of the system is between 5 to 15 kW. Low emission rates, especially low NO/sub x/-values ($\leqq$ 50 ppm) could be reached. The suited materials for the ceramic components had to be choosen and improved. For the assembly of the heat exchanger a special production technique based on the assembly of ceramic foils had to be developed. A prototype of the heater using gas fuel could be presented. With 2 refs., 4 tabs., 43 figs.

4072 **(BMFT-FB-T—86-222) Application of ceramic materials in new combustion devices for burning liquid fuel, preferably fuel oil. Final report.** Huber, J.; Nagy, C. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Hoechst CeramTec A.G., Selb (Germany, F.R.); Oertli Energietechnik G.m.b.H., Moenchengladbach (Germany, F.R.)). Dec 1986. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750130/JAW.

In this project a two stage oil vapour burner with ceramic components to vaporize liquid fuels, especially fuel oil, should be constructed, built and tested. The most important targets of the project could be reached: A reliable, complete vaporization of the fuel in two stages, the ceramic materials (silicon carbide, silicon nitride, aluminiumtitanate) fulfilled the requirements for heat insulating respectively heat conducting components, the targets for CO-, CO/sub 2/- and NO/sub x/-values were fulfilled, the projected power output of 10 kW could be overpassed (12,5 kW) and for the fieldtest the ceramic components have to be altered in construction. With 37 figs., 1 tab.

4073 (CONF-8611194—, pp 17, Paper 7) **Natural gas in gas turbines.** Loeffel, H. (Energieconsulting Heidelberg G.m.b.H., Germany, F.R. Niederlassung Ratingen). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

The author shows that low emission levels may be achieved by technological evolution in the foreseeable future which should focus however on primary measures which are more cost-effective. The good profitability of gas turbine systems may be expected to be sustained in the field of cogeneration of heat and power. In addition these favourable measures effected on the primary side may hopefully be used for retrofitting old plants to such an extent as to allow to dispense with secondary measures altogether. (orig./HSCH).

4074 (INTEG—840914) **Design of an atmospheric recirculating fluidized bed combustion research facility.** (INTEG, Vancouver, British Columbia (Canada)). 14 Sep 1984. vp. (MICROLOG—85-2073). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report compiles the design of a pilot scale recirculating fluidized bed combustor and all auxiliary equipment for the CANMET Energy Research Laboratories in Ottawa. The design is fully described in the drawings, the equipment specifications, and the design descrilptions. The drawings include combustor details, mechanical, piping and civil/structural arrangements, as well as complete instrumentation and control and electrical specifications. A complete cost estimate is included based on equipment costs derived from preliminary vendor enquiries and labour manhour estimates for installation. Major equipment prices from vendor proposals are summarized. Preliminary operating procedures are included. The operating philosophy and general instructions only are given. 5 figs., 7 tabs.

4075 (NBEPC—8703) **Chatham staged mixing burner project.** (New Brunswick Electric Power Commission, Fredericton (Canada)). Mar 1987. 104p. (MICROLOG—87-03995). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The New Brunswick Electric Power Commission, in cooperation with the Federal Department of Energy, Mines and Resources, has constructed a pilot scale boiler simulator test furnace at its Chatham, N.B., plant. This facility includes a novel pulverized fuel burner which incorporates the distributed fuel/air mixing concept to enhance the capture of sulphur oxides using sorbents and reduces the formation of nitrogen oxides. The report includes a description of the principal physical features of the plant, the test methodology, and the effect of firing rate, staging, and limestone injection on sulfur reduction. 7 figs., 3 tabs.

4076 (ORF—820811) **Protective coating for components of fossil energy conversion systems. Final report.** Sze, W.; Shimizu, H.; Gibbon, W.M. (Ontario Research Foundation, Sheridan Park (Canada)). 11 Aug 1982. 54p. (MICROLOG—86-05485). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Because of the extremely aggressive environment generated in direct-fired fluidized beds, some of the components must be given a protective coating if costly breakdowns are to be avoided. During the past year, an investigation was undertaken in which titanium diboride (TiB/sub 2/) coatings up to 50μm thick have been deposited, by means of chemical vapour deposition, on sheet coupons of some alloys used, or of potential use, in coal conversion systems. Bending, thermal fatigue, and aqueous solution corrosion testing were performed successfully, but because of edge effects apparently associated with the specimen shape, corrosion testing at elevated temperature in SO/sub 2/-bearing atmosphere could not be carried out. However, the results are sufficiently encouraging that further work is recommended in which the specimen shape will be changed. 21 figs., 4 tabs.

4077 (PB—87-230231/XAB) **Development and commercialization of pulse-combustion commercial steam boilers. Annual report, April 1986-March 1987.** Hollowell, G.T.; Belles, F.E.; Kardos, P. (Forbes Energy Engineering, Inc., Springfield, MA (USA)). Apr 1987. 30p. NTIS, PC A03/MF A01.

See also PB—86-222817.

The annual report presents the third year's accomplishments in the area of pulse-combustion-based high-efficiency commercial steam boilers with targeted inputs of 500,000 and 2,000,000 Btu/hr. A fully functional 500,000 Btu/hr experimental low-pressure steam boiler, meeting all performance objectives & equipped with a complete automatic control system, was tested at the participating manufacturer's facility & found to operate acceptably. Design revisions prior to field testing are under consideration. A prototype 2,000,000 Btu/hr low-pressure steam boiler has been successfully operated at the targeted input, meeting & slightly exceeding the efficiency goal of 86%. Design cost reduction was demonstrated by resultant efficiency loss of only about 1%. The boiler is undergoing performance testing for venting, automatic controls, and acoustics.

4078 (SFEU—850331) **Conical fluidized bed. Final report.** Donini, J.C. (Saint Francis Xavier Univ., Antigonish, Nova Scotia (Canada)). 31 Mar 1985. 20p. (MICROLOG—85-4575). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A fully instrumented liquid/solid fluidized bed of conical design was built. The conical design of the fluidization volume yields the expected increase in the ranges of sizes and densities of particles that can be fluidized. Further, particles of sufficiently different sizes and/or densities have been shown to stratify into separate beds or horizons as expected from theory. The measurement of the potential generated when the fluidized particles are charged is possible. Other instrumentation includes a pH monitor as well as conductivity, temperature and pressure sensors to further study the behaviours of the liquid, particles and overall fluidized bed. The data from all the instruments are collected and stored in a microcomputer and are thus available for further manipulation. 4 figs.

4220 Underground Engineering

4079 (CEA-CONF—8992) **Compressional acoustics in a borehole. Measurement of fracture permeability.** Samaden, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Apr 1987. 15p. (In French). (CONF-8704218—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750502/JAW.

From S.A.I.D. meeting; Paris, France (2 Apr 1987).

The detection of open fracturation of reservoirs or underground formations is very important for hydrogeology, geothermal energy and underground waste storage. The refracted compressional P wave only is studied because being faster there is less noise from interferences detection is relatively simple and easy for computer programming. 12 refs.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 3641, 3644

4080 (ASC—85) **Research into the development and fabrication of steels for use in the construction of offshore structures and Arctic vessels.** Ray, J.D.; Ackert, R.J.; McLean, M.K. (Algoma Steel Corp. Ltd., Sault Ste. Marie, Ontario (Canada)). 1985. 204p. (MICROLOG—85-2074). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The discovery of off-shore oil and gas reserves in Canadian east coast and Beaufort Sea regions has created a challenging potential for Canadian industry to supply materials and equipment. However, the material property requirements for service in these regions are very severe, surpassing those encountered in the North Sea. The main emphasis of the welding evaluation was to develop

procedures for LT60 steel which would retain adequate heat-affected zone (HAZ) properties. In addition to a literature review, the welding evaluation included three testing methods: Bead on Plate, K-Preparation and Butt. Bead on Plate welds were used in the evaluation of heat-affected zone hardness and toughness. K-Preparation welds were prepared for full thickness testing. Weld procedure qualification testing (tensile and Charpy impact) was done using the butt weld configuration. The welding literature review highlighted the importance of fine grain size, the use of precipitates to restrict grain growth in the coarse-grained HAZ, the significance of interstitials, and the effect of overall microstructure on the HAZ. 21 figs., 16 tabs.

4081 (CONF-8609337—, pp 79-90) **Engine room facilities for the ships of the future.** Paetow, K.H. (Howaldtswerke - Deutsche Werft A.G. Hamburg und Kiel, Kiel, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

Taking the new generation of HDW ships, 'Ships of the Future' (SdZ), as an example, a report is given on the future engine room facilities, because it is in these ships of the future that the influence of reduced crew numbers will play an important and essential role. The function of the engine control room, not planned into this type of ship, is taken over by the engineering crew in the ship's command centre. Two master computers control a wide-ranging monitoring and process control system. A separate computer does the loading and administrative duties in the ships of the future. Most of the engine room is below the main deck. The routing of the ventilation and exhaust ducts has been disentangled. A detailed account is given of design measures taken to ensure ease of maintenance. A battery-powered vehicle with a folding crane is available for on-board transportation jobs. As a result of the relatively low number of crewmen, work in the engine room is mainly limited to replacement of parts. Standardisation of dimensions and types has been aimed at for engine mountings, auxiliary engines and equipment. (HWJ).

4082 (CONF-8609337—, pp 111-128) **Integrated command and monitoring systems for one-man surveillance and driving operation from the ship's command centre.** Grafoner, P. (AEG A.G., Hamburg, Germany, F.R. Fachbereich Schiffbau). 1986. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

The overall economic efficiency of new ships can be substantially increased by means of the 'one man monitoring and control' method of ship command. A high degree of automation, the linking together of important operational data and control functions in a master system for the ship's engineering, and the resulting opportunities to reduce crew manning levels are characteristic features of this kind of ship's command concept. This paper lists the fundamental structures and the subsystems of this master system and its main features. Linked to the master computer by a system bus are a swell warning indicator, monitoring systems, baling and ballast systems and electricity supply. Hints are given in respect of the marine engineering requirements to be placed on the master computer and the colour video system, a presentation is made of substations for collecting and indicating measurements taken and of information processing, the bus system is described and operational experience reported. The crew on board gives a positive appraisal of the trouble-free computer-aided master system. (HWJ).

4083 (CONF-8609337—, pp 131-148) **Automation concepts for ships with a future.** Schreiber, H. (Siemens A.G., Erlangen, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750140/JAW.

From ICST '86: international congress on ship technology; Hamburg, F.R. Germany (23 Sep 1986).

As well as the reduction in crew manning levels, the automation of ship's operation is what makes the main contribution towards the greater economic efficiency which is the target for shipbuilding and shipping. A general view of the structure, method of working and capabilities of various systems for automation in ship operation by means of bus-linked or serially linked sub-systems is given with the help of block circuit diagrams. Information is given about the differences between conventionally automated and advanced ships with a safe future, the monitoring systems and automated energy generation (failure-safety, redundant systems). The paper also reports on memory-programmable, computer-aided systems for measuring and control instrumentation, a modular method of plug-in construction, and the power-failure buffer operation using lithium batteries. Some tips are given about microcomputer systems capable of multi-processing, process-linked data processing, the complexity of modern automation systems and the software configuration. (HWJ).

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 5339

4084 **(RCM—01985) Determining the retention capacity of technical aerosol-air filters in the submicroscopic range.** Henkelmann, R.; Baumgaertner, F.; Krebs, K. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). May 1985. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750181/JAW.

Using an aerosol generator and the short-lived radiotracer Na-24, discharge distributions of a maximum of 0.1 μm have been made. Technical aerosol-air filters of the size of 1 dm/sup 2/ have been charged with such a particle stream that the permeability data that could be determined by measurement of the activities of the aerosol-air filter and the subsequent analytical filters go down to 10/sup -7/. The method is very precise and allows proof of permeability with the parameters required, such as free stream velocity and differential pressure.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 3776, 4678, 4679, 4681, 4754, 4874

4085 **(CERN—87-06) Accelerators and superconductivity: A marriage of convenience. Second John Adams memorial lecture.** Wilson, M. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Jun 1987. 20p. (CONF-8611202—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700005/JAW.

From 2. John Adams memorial lecture; Lausanne, Switzerland (27 Nov 1986).

This lecture deals with the relationship between accelerator technology in high-energy-physics laboratories and the development of superconductors. It concentrates on synchrotron magnets, showing how their special requirements have brought about significant advances in the technology, particularly the development of filamentary superconducting composites. Such developments have made large superconducting accelerators an actuality: the Tevatron in routine operation, the Hadron Electron Ring Accelerator (HERA) under construction, and the Superconducting Super Collider (SSC) and Large Hadron Collider (LHC) at the conceptual design stage. Other applications of superconductivity have also been facilitated - for example medical imaging and small accelerators for industrial and medical use.

4086 **(EFI—891-42-86) Production of quasi-monochromatic beams of γ-quanta by K-ionization of relativistic ions.** Ispiryan, K.A.; Ispiryan, M.K. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700317/JAW.

It is shown that by K-ionization of relativistic ions produced either by their head on collision with laser photons, or during their passage through thin targets, one may obtain quasimonochromatic beams of γ-quanta. The angular and spectral distributions of such γ-beams are calculated as well as some estimates of their intensity are carried out. 8 refs.

4087 Desy and high-energy physics. Voss, G.h. (Deutsches Elektronen-Synchrotron DESY, Hamburg). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 98-121(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

The West German DESY laboratory programs, accelerators, and storage rings are discussed. (AIP)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 3183, 3189, 3190, 3191, 3192, 3193, 3195, 3196, 3200, 4020, 4024, 4179, 4287, 4681, 4752, 4967, 5096

4088 (CRN-VIV—20) Vivitron: mechanical aspects of the Vivitron structure. Gaudiot, G.; Koenig, P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Nov 1985. 55p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750243/JAW.

The insulators used allow to look for a mechanical solution of the Vivitron column. The insulators, the geometrical conditions and the structure principle are presented. Previous calculations give among others, the support reactions under loads. The mechanical characteristics of materials are given; dimensioning is found more easily thanks to Hercule code. Form and assembling of elements are detailed. Generator and thank are recalled.

4089 (CRN-VIV—23) Study group of Vivitron: research program 1985. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750086/JAW.

The design of the machine internal structure has been completed. Test experiments have been performed on the post insulators and on the tube activity at the Strasbourg CN and MP machines. Mechanical study of a structure partition of Vivitron is presented, gamma radiation flux has been measured along the accelerator tank of the MP tandem. Design for the belt charging system for the Vivitron accelerator has been pursued. A study has been started to find a new material which could be used as a charging belt in replacement of the cotton rubber belts used in the MP tandem.

4090 (CRN-VIV—25) Contribution to the study of a charge selector for the new accelerator Vivitron. Nadji, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jun 1986. 68p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750087/JAW.

The new Tandem 35 MeV electrostatic accelerator in Strasbourg is briefly described. The solution chosen to transport, focus and scatter the beam between the two strippers is presented. It is a charge selector and is double-aimed: first to transmit only one charge state to the second stripper; second to focus again, in this second stripper, the divergent beam coming from the stripper near the end electrode. Ions with charge 5/sup +/ and 15/sup +/ have been studied at 20 MV and 35 MV voltages.

4091 (CRN-VIV—26) Mechanical aspects of Vivitron structure. Gaudiot, G.; Koenig, R.; Esteve, T.; Peter, R.; Cherrier, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1986. 40p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750466/JAW.

Principle of settlement and assembly of the structure hooked on the inner wall of the pressure tank has been described. The study of a bay under mainly static loads allow to know the stresses in the bars. A complementary calculation, included a dynamic one, on the whole structure is presented. Before, some minor modifications have been given and a long duration traction test of an insulator is presented.

4092 (CRN-VIV—27) Injector. New propositions designed around the current tandem injector. Haas, F.; Heng, G.; Hoffmann, J.; Muller, C.; Rebmeister, R. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Dec 1986. 20p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750467/JAW.

Two solutions resuming the injector equipment of the current tandem have been studied; a new channel is added to the injector. The injection energy is 250 keV.

4093 (GANIL-R—86-13) Data acquisition with CAB. Roy, D. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Dec 1986. 83p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750468/JAW.

CAB is a microprocessor set below the acquisition computer. Settling and role of CAB are presented in detail, together with the data initialization.

4094 (GSI—87-31-Prepr.) Present status of the GSI-SIS/ESR project. Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1987. 17p. (CONF-8705195—1-Prepr.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750172/JAW.

From International symposium on collective phenomena in nuclear and subnuclear long range interaction in nuclei; Bad Honnef, F.R. Germany (4 May 1987).

The author presents a review about the project of a synchrotron and a storage ring for heavy ions at GSI. Some experimental possibilities are discussed. (HSI).

4095 (IAEA-TECDOC—428, pp 185-193) **Research and development in the field of accelerator physics and technology at the Institute for Nuclear Studies at Swierk.** Pachan, M.; Wojtowicz, S. (Institute for Nuclear Studies, Otwock-Swierk, Poland). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

Developmental work in accelerator physics and technology at the Institute for Nuclear Studies at Swierk is described. The work was carried out in three main directions: Van de Graaff electrostatic generators; proton linear accelerator; betatron as electron and X-ray source. New developments are connected with cyclotron and high power electron beam machines. The latter are intended for different industrial applications.

4096 (IAEA-TECDOC—428, pp 195-200) **Status and development of windowless high power electron beam accelerators.** Dietrich, E.O.; Dietrich, W. (Leybold-Heraeus G.m.b.H. und Co. K.G., Hanau, Germany, F.R.). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

LEYBOLD-HERAEUS is developing, constructing and operating high power electron beam (EB) accelerators since more than 20 years. Concerning flue gas treatment by electron beam ionization a specific type of EB accelerator could be very useful. This is the so called non vacuum or windowless high power electron beam accelerator. This accelerator consists of two main assemblies: the upper section containing the beam-generator components and a lower section containing a multistage vacuum chamber system and a magnetic lens system, which is replacing the window between accelerator and flue gas reactor of conventional systems. Actually the non vacuum EB accelerators of LEYBOLD-HERAEUS have a beam voltage of 180 kV and a beam power of 60 kW. On the basis of the available technology of LEYBOLD-HERAEUS it is planned to develop an accelerator for large volumes of flue gas with: a beam voltage 250 kV and a beam power 250 kW. The most important advantages of the system are the extremely low losses of the EB power because of the non existing window. The technology has to be qualified in a demonstration unit of a power plant in 1987/1988. 2 figs.

4097 **(LAPP-EXP—86-71) Electron-positron linear collider as a B-anti B-meson factory.** Amaldi, U.; Coignet, G. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jul 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750465/JAW.

In this note a new scheme of machine is proposed, based on improved superconducting cavity technology. A "threshold machine" is chosen since the possibility of selecting the B-meson type is considered.

4098 **Electron accelerators for research at the frontiers of nuclear physics.** Grunder, H.A.; Hartline, B.K.; Corneliussen, S.T. (Continuous Electron Beam Accelerator Facility (CEBAF), Newport News, Virginia 23606). *AIP (American Institute of Physics) Conference Proceedings;* **161**: No. 1, 100-122(10 Oct 1987). (CONF-8610239—).

From Electron scattering in nuclear and particle science: in commemoration of the 35th anniversary of the Lyman-Hanson-Scott experiment; Urbana, IL, USA (23 Oct 1986).

Electron accelerators for the frontiers of nuclear physics must provide high duty factor (>80%) for coincidence measurements; few-hundred-MeV through few-GeV energy for work in the nucleonic, hadronic, and confinement regimes; energy resolution of $\sim 10^{-4}$; and high current ($\geq$100 μA). To fulfill these requirements new machines and upgrades of existing ones are being planned or constructed. Representative microtron-based facilities are the upgrade of MAMI at the University of Mainz (West Germany), the proposed two-stage cascade microtron at the University of Illinois (U.S.A.), and the three-stage Troitsk "polytron" (USSR). Representative projects to add pulse stretcher rings to existing linacs are the upgrades at MIT-Bates (U.S.A.) and at NIKHEF-K (Netherlands). Recent advances in superconducting rf technology, especially in cavity design and fabrication, have made large superconducting cw linacs become feasible. Recirculating superconducting cw linacs are under construction at the University of Darmstadt (West Germany) and at CEBAF (u.S.A.), and a proposal is being developed at Saclay (France).

4099 **Facilities for new acceleration techniques.** Fernow, R.C. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 37-45(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

We review possible facilities which are suitable for studying new concepts in acceleration and focusing mechanisms. Two facilities are discussed in detail. The Argonne National Laboratory Wakefield Linac is nearing completion and should begin experiments on wakefield processes in the Fall of 1986. A Laser Accelerator Test Facility has been proposed for Brookhaven National Laboratory and could be ready for laser related experiments by the end of 1987.

4100 **Pulse power: Applications to accelerators.** Anselmo, A.; Greenwald, S.; Nation, J.A. (Laboratory for Plasma Studies and School of Electrical Engineering, Cornell University, Ithaca, NY 14853-5401). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 46-70(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

In this paper we discuss the potential role of pulse power technology for future high gradient accelerators. Compared to present day pulse power sources the requirements are quite modest and, with the exception of a detailed testing of high repetition rate systems, all components have been tested over several years. We review pulse power technology and its use in collective acceleration of ions and electrons. An account is presented of a new concept for collective electron acceleration through the parametric excitation of fast waves on beams. A summary is given also of achievements in the generation of high power microwave signals, and a discussion presented of structure requirements to take full advantage of the newly evolving ultra high power sources.

4101 **Experimental, theoretical and computational studies of the plasma beat wave accelerator at UCLA.** Joshi, C.; Katsouleas, T.; Clayton, C.E.; Mori, W.B.; Kindel, J.M.; Forslund, D.W. (University of California, Los Angeles). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 71-104(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

In this paper we report on the recent progress on the Plasma Beat Wave Acceleration Scheme at UCLA as described in a series of talks by the authors at the Symposium on Advanced Accelerator Concepts in Madison. This paper is organized as follows: 1. Introduction 2. Experimental Program 3. Theory Program 4. Simulations Program 5. Summary

4102 **What is the most efficient high-energy accelerator?.** Channell, P.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 183-193(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

The accelerator configuration that will result in the largest fraction of accelerator kinetic energy transferred to accelerated particles is explicitly determined from general principles.

4103 **Multi-TeV muon colliders.** Neuffer, D. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 201-208(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

The possibility that muons may be used in a future generation of high-energy high-luminosity $\mu^+ \mu^-$ and μ-p colliders is presented. The problem of collecting and cooling high-intensity muon bunches is discussed and ionization cooling is described. High-energy collider scenarios are outlined; muon colliders may become superior to electron colliders in the multi-TeV energy range.

4104 **Solid state accelerator.** Chen, P.; Noble, R.J. (Stanford Linear Accelerator Center, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 222-230(5 May 1987). (CONF-8608123—). Contract AC03-76SF00515.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

We present a solid state accelerator concept utilizing particle acceleration along crystal channels by longitudinal electron plasma waves in a metal. Acceleration gradients of order 100 GV/cm are theoretically possible, but channeling radiation limits the maximum attainable energy to 10^5 TeV for protons. Beam dechanneling due to multiple scattering is substantially reduced by the high acceleration gradient. Plasma wave dissipation and generation in metals are also discussed.

4105 **ANL experiment for a wake field accelerator using an RF structure.** Ruggiero, A.G.; Schoessow, P.; Simpson, J. (Argonne National Laboratory, Argonne, Illinois 60439, USA). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 247-265(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Theoretical foundation for a Wakefield Accelerator using rf cavities has been completed. Thus experiments are in the planning to test the numerical and analytical results determined. The computational work and the experiments being planned are discussed in this presentation. (AIP)

4106 **Status of switched-power linac studies at BNL and CERN.** Aronson, S. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 283-297(5 May 1987). (CONF-8608123—). Contract AC02-76CH00016.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Current status of Switched-Power Linacs being studied at BNL and CERN is presented. Laser-induced vacuum photodiode switching and radial transmission lines have been studied by way of computer simulation and experiment. (AIP)

4107 **SLAC lasertron project.** Sinclair, C.K. (Stanford Linear Accelerator Center, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 298-312(5 May 1987). (CONF-8608123—). Contract AC03-76SF00515.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

SLAC has a program underway to develop an efficient high power microwave source for accelerator applications employing a photoemission cathode, the so-called lasertron. After a brief discussion of the lasertron idea, the various elements of the current program are reviewed. A proof-of-principle experiment to build a 35 MW, 70% efficiency, S-band microwave source is nearing completion. Actual RF power testing is expected to begin in late 1986 or early 1987.

4108 **High repetition rate linear colliders at TeV and GeV energies.** Wurtele, J.S.; Sessler, A.M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 322-334(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

The parameters for a prototype two-beam accelerator are presented. Such a machine could serve as both a test facility for new accelerator technology and as a B-B-bar factory. It was found that the required positron flux could be reduced by operating the accelerator with a low density positron bunch at 12.5 GeV and a high density electron bunch at 2 GeV. A survey of previous work on two-beam accelerators is given, as well as new parameters for high energy colliders at 300 GeV x 300 GeV and 1 TeV x 1 TeV.

4109 **Electron sources for advanced accelerator experiments.** Fraser, J.S. (AT-7, MS H825 Los Alamos, National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 335-344(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Acceleration experiments of various kinds have been proposed that required electron bunchese of extremely low emittance and of short duration. The potential of conventional electron sources and of laser-illuminated photoemitters to satisfy these requirements is discussed. Described are experiments in progress to explore the capabilities of photoemitter electron sources in higher average power devices, such as free-electron lasers.

4110 **Radio frequency phase in the FEL section of a TBA.** Kuenning, R.W.; Sessler, A.M.; Sternbach, E.J. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 371-385(5 May 1987). (CONF-8608123—). Contract AC03-76SF00098.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Analysis of the rf phase in the FEL section of a two beam accelerator using a many particle simulation has been done. The simulation was based upon equations describing the FEL in the resonant particle approximation. The main emphasis of the analysis is on the evolution of the radiation-amplitude and phase of the FEL electrons. (AIP)

4111 **Wake fields in 1 cm structures.** Selph, F. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 433-434(5 May 1987). (CONF-8608123—). Contract AC03-76SF00098.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Results from a study of the effects of transverse wakefields in a 1-Te Two-Beam accelerator are presented. (AIP)

4112 **Laser focusing of high-energy charged-particle beams.** Channell, P.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 519-530(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

It is shown that laser focusing of high-energy charged-particle beams using the inverse Cherenkov effect is well suited to applications to large linear colliders. Very high gradient (>0.5 MG/cm) lenses result that can be addeded sequentially without AG cancellation. These lenses are well understood, have small geometric aberrations, and offer the possibility of correlating phase and energy aberrations to produce an 'achromatic' final focus.

4113 **Concluding talk-seminar on critical issues in development of new linear colliders.** Panofsky, W.K.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 Presented at University of Wisconsin, August 29, 1986). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 553-566(5 May 1987). (CONF-8608123—). Contract AC03-76SF00515.

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

The motivation for a TeV electron-positron collider is revealed when such a collider is compared with a TeV proton-antiproton collider. The signal-to-background ratio for electron-positron collisions at the constituent energy equivalent to a hadron collider is greatly superior, luminosities for electron-positron colliders in the quark regime is higher than that attainable in storage ring colliders, and "none of the energy thresholds for the new phenomena predicted to exist in the next energy range are quantitatively predicted." Studies of different methods of accelerating electrons and positrons have ensued, actively. A review of the results of these studies is presented. (AIP)

4114 **Personal dosimetry in a mixed field of high energy muons and neutrons.** Cossairt, J.D.; Elwyn, A.J. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 415-423 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

High energy accelerators quite often emit muons. These particles behave in matter as would heavy electrons and are thus difficult to attenuate with shielding in many situations. Hence, these muons can be a source of radiation exposure to personnel and suitable methods of measuring the absorbed dose received by these people is obviously required. In practical situations, such muon radiation fields are often mixed with neutrons, well-known to be an even more troublesome particle species with respect to dosimetry. In this paper, we report on fluence measurements made in such a mixed radiation field and a comparison of dosimeter responses. The authors conclude that commercial self-reading dosimeters and film badges provide an adequate measure of the absorbed dose due to muons.

4115 **Neutron leakage through an iron shield at an high energy accelerator.** Elwyn, A.J.; Cossairt, J.D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 424-431 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The spectrum of those neutrons, produced in the interactions of high-energy hadrons at the Tevatron, that leak through an iron shield was determined from fluence measurements with a multis-

phere spectrometer. As expected, a peak was observed in the distribution at neutron energies of — . 01-1 MeV. This intermediate energy peak was found to be completely gone in measurements performed after the iron shield was augmented with —0.9 m of concrete. The quality factor measured under the latter condition was a factor of two lower than in the all-iron configuration. These results along with an analysis of additional fluence measurements taken in the vicinity of the neutron source are discussed.

4116 **Measurements of neutron spectra and doses in the Tevatron tunnel for up to 800 GeV circulating proton beams.** Freeman, W.S.; Elwyn, A.J.; Yurista, P.M.; Mc Caslin, J.B.; Sun, R.K.S.; Swanson, W.P. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 432-441 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Measurements of the neutron fluence and energy spectra in the Fermilab tunnel during Tevatron operation are described. Multi-sphere neutron moderators and /sup 6/Li I(Eu) scintillators, as well as other instruments, were used under various accelerator operating conditions. Comparison is made between neutron spectra derived from three unfolding codes and reasonable agreements is found. In addition to the usual slowing-down and thermal components, a prominent peak is evident at about 230 keV. About 30% of the fluence is between 0.1 and 1.0 MeV, with only —4% above 10 MeV. The median energy is about 60 keV and the average quality factor is close to seven. Upper limits are also given for the dose due to photons and minimum ionizing particles.

4117 **Radiation interlocks - The choice between conventional hard-wired logic and computer-based systems.** Crook, K.F. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 152-160 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC03-76SF00515.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

During the past few years, the use of computers in radiation safety systems has become more widespread. This is not surprising given the ubiquitous nature of computers in the modern technological world. But is a computer a good choice for the central logic element of a personnel safety system? Recent accidents at computer controlled medical accelerators would indicate that extreme care must be exercised if malfunctions are to be avoided. The Department of Energy (DOE) has recently established a sub-committee to formulate recommendations on the use of computers in safety systems for accelerators. This paper reviews the status of the committee's recommendations, and describes radiation protection interlock systems as applied to both accelerators and to irradiation facilities. Comparisons are made between the conventional (relay) approach and designs using computers.

4118 **CEBAF: A new high power electron accelerator.** Stapleton, G.B. (SURA/CEBAF, 12070 Jefferson Ave., Newport News, VA 23606). pp 512-520 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The requirement for a Continuous Electron Beam Accelerator Facility (CEBAF) capable of delivering up to 200 μA at about 4 GeV for studies in nuclear and particle science has been felt for a long time. Linac/PSR and microtron-type accelerators were the technological solutions to attain up to 100% duty factor. Recent advances in superconducting RF cavity development provide an elegant and energy conserving way of achieving this goal. The CEBAF recirculating accelerator, a new facility based on superconductivity, is due to be completed in 1992 at a new site in Newport News, Va. The paper briefly describes the new facility and gives an overview of the radiation control measures.

4119 **An analysis of groundwater contamination from the operation of a 6-GEV continuous electron beam accelerator.** Lee, D.W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831-6049). pp 521-528 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The potential contamination of groundwater in the vicinity of a beam dump associated with a 6-GeV continuous electron beam accelerator has been analyzed considering the site hydrology. The potential contamination arising from photoneutron activation of soil and the subsequent leaching, transport, and decay of tritium are examined. The analysis accounts for dilution from groundwater transport and infiltration of precipitation. The results demonstrate that dilution reduces the concentration of tritium in the groundwater by one order of magnitude from a simple production and transport model that does not consider the effect of dilution.

4120 **Superconducting accelerator technology.** Grunder, H.A.; Hartline, B.K. (Continuous Electron Beam Accelerator Facility, Newport News, VA 23606). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 37-52(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Modern and future accelerators for high energy and nuclear physics rely increasingly on superconducting components to achieve the required magnetic fields and accelerating fields. This paper presents a practical overview of the phenomena of superconductivity, and describes the design issues and solutions associated with superconducting magnets and superconducting rf accelerating structures. Further development and application of superconducting components promises increased accelerator performance at reduced electric power cost.

4121 **Future accelerator technology.** Sessler, A.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 53-62(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00098.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A general discussion is presented of the acceleration of particles. Upon this foundation is built a categorization scheme into which all accelerators can be placed. Special attention is devoted to acelerators which employ a wake-field mechanism and a restricting theorem is examined. It is shown how the theorem may be circumvented. Comments are made on various acceleration schemes.

4122 **Relativistic heavy ion facilities: Worldwide.** Schroeder, L.S. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 205-225(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00098.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A review of relativistic heavy ion facilities which exist, are in a construction phase, or are on the drawing boards at proposals, is presented. These facilities span the energy range from fixed target machines in the 1—2 GeV/nucleon regime, up to heavy ion colliders of 100 GeV/nucleon on 100 GeV/nucleon regime. In addition to specifying the general features of such machines, I will also outline the central physics themes to be carried out at these facilities, along with a sampling of the detectors which will be used to extract the physics.

4123 **Summary of accelerator physics presentations.** Koehler, P.F.M. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 303-306(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief summary of the talks on accelerator physics presented at this conference, Intersections Between Particle and Nuclear Physics , is given. New accelerator facilities and technologies, beam cooling, and the experiments were part of these discussions.

4124 **Where is the SSC today?.** Tigner, M. (Supercollidier, URA Design Center, LBL, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 366-376(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

The status of the ongoing studies for the Superconducting Super Collider as of 1985 is detailed. A time schedule for major objectives, such as the super- superconducting magnets, is proposed. (AIP)

4125 **The SSC - Where are we now.** Tigner, M. (Superconducting Super Collider, Universities Research Association, c/o Lawrence Berkeley Lab., Univ. of California, One Cyclotron Road, Mail Stop 90-4040, Berkeley, CA 94720). pp 27-32 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The DOE has committed SSC R and D funds for FY85. A brief history of events leading up to that commitment and a description of accomplishments to date and organization plans are given. The purpose of this paper is to give an up to data status report on the Superconducting Super Collider - the SSC. The author gives a brief recollection of the events that led to the initiation of the SSC project and subsequently describe the range of technical parameters contemplated for the SSC. This is followed by a short discussion of the milestones in the SSC R and D program, description of the organization, and finally status report on the SSC related activities today and in the near future.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 4027, 4112, 4122, 4123, 4163, 4169, 4170, 4171, 5336

4126 **(BNL—40156) National Synchrotron Light Source users manual: Guide to the VUV and x-ray beam lines.** Gmuer, N.F.; White-DePace, S.M. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001464/JAW.

The success of the National Synchrotron Light Source in the years to come will be based, in large part, on the size of the users community and the diversity of the scientific disciplines represented by these users. In order to promote this philosophy, this National Synchrotron Light Source (NSLS) Users Manual: Guide to the VUV and X-Ray Beam Lines, has been published. This manual serves a number of purposes. In an effort to attract new research, it will present to the scientific community-at-large the current and projected architecture and capabilities of the various VUV and x-ray beam lines and storage rings. We anticipate that this publication will be updated periodically in order to keep pace with the constant changes at the NSLS.

4127 (BNL—52090, pp 1-30) **Interdependence of parameters for TeV linear colliders.** Palmer, R.B. (Stanford Linear Accelerator Center, CA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—). Contract AC03-76SF00515.

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Approximate formulae for many of the relations governing the design of linear colliders are gathered together in this review. Expressions are discussed under the following headings: damping ring, acceleration, emittance preservation, final focus, interaction point and beamstrahlung. Using these formulae a consistent parameter set is derived.

4128 (BNL—52090, pp 67-75) **Exotic damping ring lattices.** Palmer, R.B. (Stanford Linear Accelerator Center, CA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—). Contract AC03-76SF00515.

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Three types of damping ring lattices: a) conventional, b) wiggler lattice with finite α, and c) wiggler lattice with $\alpha = 0$ have been compared. The attainable equilibrium emittances for the three cases assuming a constraint of the attainable longitudinal impedance of 0.2 ohms was calculated. The emittances obtained are roughly in the ratio 4:2:1 for a, b, and c.

4129 (BNL—52090, pp 76-86) **Damping rings with zero momentum compaction, and other issues.** Chattopadhyay, S.; Chao, A.; Lee, S.Y.; Rivkin, L.; Ruth, R. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

There are a large number of interesting effects that come into play for an $\alpha = 0$ lattice. A preliminary scan through these effects have been attempted in this report. The more relevant issues are found to be: (1) energy spread within the bunch due to longitudinal impedance, Z/sub parallel/; (2) Phase slippage due to α_1, α_2, α/sub epsilon/; (3) Maximum allowed value of α_1 that assures sufficiently slow instability growth rate; and (4) Instability issues arising from α_2, α/sub epsilon/ when $\alpha_1 = 0$ (not addressed in this report). Most of the effects studied seem benign, with the possible exception of item (3) above. However, it is necessary to continue these studies in much more detail than is presented here if the option of zero momentum compaction is seriously considered in the future. If these issues are shown to impose insurmountable difficulty for the $\alpha = 0$ lattice, one might consider further the possibility of having a finite-but-negative α by letting wigglers dominate the lattice.

4130 (BNL—52090, pp 87-93) **EPA brilliance.** Delahaye, J.P. 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

As a part of the LEP injector chain, the main function of the Electron Positron Accumulator (EPA) consists in fast accumulation and damping at a fixed energy of 600 MeV in order to build up eight high intensity bunches ($8 \times 2.5\ 10^{10}$) of electrons and positrons with a high injection rate and beam stability. This is the reason why the main parameters of EPA were chosen to favor bunch stability in LEP and in the PS at injection up to at least the nominal intensity to the detriment of beam density and brilliance. The main performance limitation was anticipated to come from a vertical mode coupling instability excited by the transverse impedance with a threshold of 5.10^{10} particles per bunch. In fact, a charge of $2.1\ 10^{11}$ electrons in a single bunch and 6.10^{11} electrons in eight bunches could be accumulated with an injection efficiency of 80% and without any sign of vertical instability. For vanishing intensity, the beam parameters are close to the expected values. But the variation with the intensity of the basic beam parameters pointed out a strong perturbation of the beam quality and therefore of the brilliance. The achieved brilliance as a function of the charge per bunch is shown. Finally, some possible improvements of the beam brilliance are discussed in the conclusion.

4131 (BNL—52090, pp 94-104) **Performance comparisons of low emittance lattices.** Delahaye, J.P.; Zisman, M.S. (CERN, Geneva, Switzerland). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The results of a performance analysis of four low emittance electron storage ring lattices provided to the authors by various members of the Lattice Working Group is presented. Altogether, four lattices were investigated. The beam energies of the four lattices are, respectively, 1.1, 2, 3, 4 GeV). A brief summary of the lattice parameters relevant to this study is given. The performance issues studied include an estimation of the longitudinal emittance expected for each lattice based on the effects of the longitudinal microwave instability, an estimation of the transverse emittance growth of the (required) dense bunches under the influence of intrabeam scattering (IBS), and an estimate of the Touschek lifetime. The analysis described here has been carried out with the LBL accelerator physics code ZAP.

4132 (BNL—52090, pp 105-109) **Linac transport and acceleration.** Bisognano, J.; Decker, G.; Henke, H.; Leemann, C.; Mondelli, A.; Sessler, A.; Wurtele, J. 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The acceleration of intense bunches maintaining high brightness is limited both by single-particle effects, e.g., misalignments, injection errors, and rf-steering, and collective phenomena, where the effects of the longitudinal and transverse wakefield on particles within a single bunch are the most severe. The working group has considered both problems and potentials of linac acceleration from ~50 MeV to 1 GeV for free electron laser (FEL) applications, as well as from a few Gev to 1 TeV for linear colliders. The outlook for free electron lasers is bright: no fundamental problems seem to arise in the acceleration of peak currents in excess of 100 A with small emittance and low momentum spread. The situation of linear colliders is more complex and more difficult. Two examples, one operating at 11.4 GHz, the other at 30 GHz, are used to illustrate some of the difficulties and the exceedingly tight tolerances required. Both examples are based on round beams, and thus neither benefit from the advantages of flat beams nor address the increased care required in transporting beams of very small emittance in one plane. The working group acknowledges, but did not explore, promising concepts for colliders based on RF superconductivity.

4133 (BNL—52090, pp 115-124) **Beam transport and acceleration in a 30 GHz 1 TeV linac.** Henke, H. (CERN, Geneva, Switzerland). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Some RF parameters and the beam-induced electromagnetic fields, the longitudinal and transverse wake fields, are given for a 30 GHz disc-loaded structure. Their effect on the transverse motion of an intense electron bunch is analyzed numerically in a 1 TeV linac. It is found that with quadrupole fields of 120 T/m an energy spread of 2% is required in order not to increase the injection emittance, 3×10^{-6} m, by more than 25%. A typical permitted injection jitter is then 15 μm, while the transverse misalignment jitter of the cavities is 13 μm and that of the quadrupoles is 0.12 μm.

4134 **(CEA-N—2514) Beam dynamics in long transit time linac cavities for heavy ion boosters.** Lapostolle, P.; Valero, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Mar 1987. 328p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750093/JAW.

A new accurate and relatively fast formalism has been derived for non relativistic beam dynamics through long accelerating elements. This work was initiated by the development of heavy ion booster cavities, in particular of helix type as in Saclay, which present no exact symmetry; its general character makes it applicable to other systems.

4135 **(DOE/ER/40150—38) Advanced nonlinear theory: Long-term stability at the SSC.** Heifets, S. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 50p. (CEBAF-PR—87-027). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001720/JAW.

This paper discussed the long-term stability of the particle beams in the Superconducting Super Collider. In particular the dynamics of a single particle beam is considered in depth. The topics of this paper include: the Hamiltonian of this particle approach, perturbation theory, canonical transformations, interaction of the resonances, structure of the phase space, synchro-Betatron oscillations, modulation diffusion and noise-resonance interaction. 36 refs. (LSP)

4136 **(EFI—904-55-86) Optimization of charged particle acceleration rate over wave parameters in the scheme with acceleration by surface electromagnetic waves.** Ter-Arutyunyan-Savvidi, N.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700320/JAW.

The rate of acceleration of charged particles accelerated by surface electromagnetic wave is optimized over the index of refraction of material and the angle of incidence of the wave at optimal polarization. In case of non-optimal polarization, the acceleration rate is optimized over the angle of incidence for KRS - 5 glass.

4137 **(GSI—87-40-Prepr.) Space charge dominated beams.** Hofmann, I. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1987. 20p. (CONF-8610108—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750164/JAW.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

After an introductory section on the relationship between emittance and beam Coulomb energy we discuss the properties of space charge dominated beams in progressive steps: from uniformly charged bunched beams to non-uniformly charged beams to correlation effects between particles (simulation beams or 'crystalline' beams). A practical application can be found in the beam dynamics of a high-current injector. The concept of correlation energy is of practical interest in computer simulation of high-brilliance beams, where one deals with an artificially enhanced two-particle Coulomb energy, if many real particles are combined into one simulation super-particle. This can be a source of non-physical emittance growth. (orig./HSI).

4138 **(ISN—86-75) Contribution to the central region study of the first cyclotron of the Rhone-Alpes accelerator system.** Khallouf, A. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1986. 166p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750474/JAW.

Some changes seemed necessary such as the structure of the central region in order to obtain good centring and good axial and radial stabilities for the different conditions of acceleration. The most simple calculations of the center of cyclotron already developed such as the acceleration in a constant electric field, but with enough regions to obtain a good precision have been resumed. As analytic tool a computer program calculates the trajectories of a charged particle given its characteristics and the conditions of injection, and the parameters of the system of acceleration and guiding. The program calculates orbit of the particle. A criterion of judgement to permit modifications of the hypothesis leading to the solution needed to obtain good working conditions for the cyclotron has been established.

4139 **(KFK—4068) On the physics of intense, electrostatically accelerated cluster-ion beams.** Moser, H.O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Mar 1986. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750158/JAW.

The development work performed on the cluster-ion accelerators at Karlsruhe and Lyon has led to beam currents and flux densities of the order of 10 A/sub 0/ and 1 A/sub 0//cm/sup 2/, respectively, at kinetic energies of the order of 10 eV/atom. Besides the well-known space-charge limit, an additional limiting effect appears which is caused by collisions of cluster ions among themselves and with background gas. The ensuing partial evaporation of cluster ions leads to the production of additional background gas and may cause instability if a limiting flux density is exceeded. Scaling relations, derived from the limiting processes, suggest that by use of band-shaped beams it should be possible to increase the current by one order of magnitude in the Karlsruhe accelerator. Another result, which is important for the control of the energy per atom, is that both for large (10/sup 5/ atoms/charge) and for small (100 atoms/charge) cluster ions the number of atoms per charge is inversely proportional to the electron current in the ionizer. This effect is explained by multiple charging and symmetrical fractioning of large and small cluster ions, respectively.

4140 **(LAL-RT—87-01) Mixed finite element method for particle simulation in lasertron.** Le Meur, G. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 4p. (CONF-870302—253). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750483/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A particle simulation code is being developed with the aim to treat the motion of charged particles in electromagnetic devices, such as Lasertron. The paper describes the use of mixed finite element methods in computing the field components, without derivating them from scalar or vector potentials. Graphical results are shown.

4141 **(SAND—87-2370C) Channel formation for the IBEX density-channel tracking experiment.** Freeman, J.R.; Nelson, W.E. (Sandia National Labs., Albuquerque, NM (USA); Science and Engineering Associates, Inc., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8709146—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001359/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

This paper describes theoretical studies of density-channel formation. This work was motivated by the upcoming density-channel tracking experiments planned for the IBEX accelerator at Sandia. Analyses of the electrical circuit behavior, blast-wave theory, and preliminary 1-D radiation-hydrodynamics code results are presented. 10 refs.

4142 **Cooling of stored beams.** Mills, F.E. (Fermi National Laboratory, Batavia, Illinois). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 226-237(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Beam cooling methods developed for the accumulation of antiprotons are being employed to assist in the performance of experiments in Nuclear and Particle Physics with ion beams stored in storage rings. The physics of beam cooling, and the ranges of utility of stochastic and electron cooling are discussed in this paper.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 3737, 4120, 4122, 4123, 4142, 4142, 4755, 4758

4143 (BNL—52090, pp 110-114) **Magnetic transport channel for high-energy linacs.** Henke, H. (CERN, Geneva, Switzerland). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

High-energy linacs, as proposed for future linear colliders, are a severe challenge to the magnetic transport system. The large number of magnets and the low beam emittance require tolerances on the displacement jitter in the submicron region. By choosing a low phase advance per cell, mounting the magnets two by two on rigid girders, and fixing all girders within one betatron wavelength on one beam, the tolerances are considerably relieved. The tolerances on one beam are now a few microns, and between beams they are some tens of microns.

4144 (BNL—52090, pp 125-140) **Report of the Working Group on Electron Linac Guns at the ICFA Workshop on Low Emittance Beams Brookhaven National Laboratory, March 20-25, 1987.** Smith, T.I. (Stanford Univ., CA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The group addressed the topic of high brightness injectors for electron linacs. Parameters for a target injector were adopted which were consistent with the criteria established for the workshop as a whole and possible issues involved with meeting the target parameters were examined. These included: electron guns, space charge, RF dynamics, wake fields and bunching. An approach for building the injector is outlined.

4145 (BNL—52090, pp 141-152) **High-brightness electron injectors.** Sheffield, R.L. (Los Alamos National Lab., NM). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Free-electron laser (FEL) oscillators and synchrotron light sources require pulse trains of high peak brightness and, in some applications, high-average power. Recent developments in the technology of photoemissive and thermionic electron sources in rf cavities for electron-linac injector applications offer promising advances over conventional electron injectors. Reduced emittance growth in high peak-current electron injectors may be achieved by using high field strengths and by linearizing the radial component of the cavity electric field at the expense of lower shunt impedance.

4146 (BNL—52090, pp 153-163) **Selection of high-brightness, laser-driven cathodes for electron accelerators and FELS.** Oettinger, P.E. (Thermo Electron Corp., Waltham, MA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

Very intense, low emittance pulsed beams of electrons can be generated from laser-driven cathodes either by thermionic- or photo-emission. Several hundreds of amperes of electrons per square centimeter were observed for pulse lengths up to 50 ns. A normalized beam brightness of 10^7 A/cm^2/rad^2 has been measured. These beams can be emission-gated at the cathode surface by modulating the laser-beam. Such beam bunching will generate picosecond-to-microsecond-long pulses at the source. A variety of cathodes are described, and a method of selection for specific applications is presented.

4147 **(CEA-CONF—8982) Electrostatic septum in a high intensity electron accelerator.** Koechlin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de l'Accelerateur Lineaire). Mar 1987. 4p. (CEA-DPH-N-S—2441; CONF-870302—248). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753240/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Calculations of beam power losses and equilibrium temperatures of the wires of an electrostatic septum have been carried out. The occurrence of an electromagnetic shower has been examined in the case of a metal foil septum and the longitudinal profile of the beam power losses is given.

4148 **(CERN-EP—87-104) A superconducting radiofrequency complex for molecular, nuclear and particle physics.** Amaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Jun 1987. 17p. (CONF-8705198—3; CONF-8706217—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900045/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

This paper investigates the use of superconducting radiofrequency cavities in different areas of physics. The particular areas of use and topics discussed are: free electron lasers and dc electron beams for nuclear physics, charm and tau physics, beauty factory and 10 GeV nuclear physics, Z neutral bosons and toponium factories, and finally cost estimates of an accelerator complex using these cavities. 35 refs. (LSP)

4149 **(GANIL-A—87-01) Modular design of a beam line and control process.** Beck, A.; Bru, B.; Ricaud, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 30p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750457/JAW.

The principle of the modular design of the beam lines is presented. Their operation and tuning mode are further explained. The GANIL beam lines, which were designed on this basis about 1975, are quoted as an example.

4150 **(IFVE-OEA—86-87) Fixed component reconstruction for wide-band pulses.** Bruk, V.L.; Morozov, I.G.; Tishin, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700371/JAW.

The problem of reconstruction of fixed component (RFC) of periodical pulsed signals which takes place during beam diagnoties in charged particle accelerators is considered. Calculation of erros for the amplitude and fixed component reconstruction for different types of circuits is given. The operating RFC circuit is described. 2 refs.; 6 figs.

4151 **(IFVE-OEA-OKU—86-13) Data exchange system based on the SUMMA serial highway.** Afonin, A.G.; Davydenko, Yu.P.; Mamakov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700374/JAW.

Consideration is being given to the system for data exchange between ejection and beam channel consoles realized at the IHEP accelerator provided with SUMMA serial highway and controlled by SM-4 computer. The software for control of data exchange is written in the FORTRAN-4 and uses the communication driver for SUMMA equipment as well as subprogram library CAMLIB. SUMMA serial highway provides sifficient reliability and the rate of data exchange for rather long communication line. The data transmission speed was equal to 1 megaboud. 12 refs.; 2 figs.

4152 **(IFVE-ONF-OP-OEA-ORI—86-129) Hadron channel No. 23 of tagged neutrino complex.** Akopyan, M.V.; Batalov, A.A.; Bugorskij, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700384/JAW.

The optical scheme of the hadron channel N23 of the IHEP tagged neutrino complex is given. The measured beam characteristics of secondary particles are considered. The beam shaping channel for secondary particles consists of two beam bending magnets and seven quadrupole lenses. The secondary emission chambers are used to determine the proton beam profiles and for beam quidance on the target. The target is a 7 x 100 mm aluminium rod. The secondary particle beam characteristics are measured by scintillation counters and hodoscopes, as well as threshold and differential Cherenkov counters at the proton beam intensity of 10/sup 10/ particles/cycle. During 3 x 10/sup 13/ protons dump on the target, the positive and negative particle fluxes are (4 +- 2) x 10/sup 10/ and (6 +- 2) x 10/sup 9/, respectively. 3 refs.; 5 figs.

4153 **(Juel—2121) Realization of a booster-target for a spallation-neutron source in regard to thermalhydraulics and material load.** Weisweiler, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1987. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750159/JAW.

For a spallation plant (SNS), which has been completed recently, a second target is previewed as a booster with additional multiplication by neutron fission. This allows a multivarious use of the SNS. As spallation material uranium is proposed. A pulsed proton beam (40 μA, 10 Hz) is directed on the target, which produces about 2 MW. In this paper several target designs are presented and investigated under various aspects above all the thermal hydraulic one. Further main points are, besides questions of materials, thermostresses occuring in the target elements, loads by irradiation and thermal cycling caused by the pulsed proton beam and by switch-on and -off transients. Using metal α-uranium as spallation material with zircaloy2-cladding of the target-elements, in all target concepts considered here, maximum temperatures below 400degC can be achieved by cooling with sodium as well as with water. By the use of water, a temperature level can be attained, so that the load by thermostresses is below admissible values. This is equally true, when making use of UMo10, which shows according to the experimental data available up to now better behaviour under thermal cycling than unalloyed uranium.

4154 (LA—10956-C, pp 102-111) **Status and plans for computer facilities at LAMPF.** Hoffman, E.W. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The current status of computer resources provided at LAMPF for the support of Medium Energy Physics research and thoughts and plans for the near future are discussed. The areas converse are data acquisitive, data analysis, and computer maintenance.

4155 **(LAL—86-02) Measurement of punch-through particle fluxes from a 200 cm long beam dump hit by a 300 GeV/c pion beam.** Badier, J.; Bemporad, C.; Boucrot, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Feb 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750249/JAW.

We present a measurement of the particle flux punching through tungsten and iron beam dumps; the NA3 spectrometer was used. Momentum spectra and spatial distributions were determined for pions above 3 GeV/c and for strange particles (K/sup +-/, K/sup o//sub s/, Λ, γ; 15 < p < 50 GeV/c). Information on the effective attenuation length for strange particles were obtained by comparing the results from dumps of different lengths (200 and 220 cm). 4 refs; 7 figs.

4156 **(LAL-RT—87-03) Photoemission in nanosecond and picosecond regimes obtained from macro and micro cathodes.** Boussoukaya, M.; Bergeret, H.; Chehab, R.; Leblond, B.; Franco, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 4p. (CONF-870302—254). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750484/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For Lasertron studies at LAL, results obtained from tests on different photocathodes are given below. Using respectively two Nd: YAG lasers (a nanosecond one and a picosecond one) we have determined the level and the intensity of pulsed photoemission and the photoelectric yield in UV, green and infrared lights. We obtained a total current of more than 1 A with nanosecond width from a single W needle, and photoconversion yield of more than 1 was reached in green and UV lights. In classical pulsed photoemission, obtained photoconversion yield from LaB/sub 6/ photocathode was of about 10/sup -3/ in higher fields.

4157 **(PS-LPI-Note—86-17) Simulation of trajectory control in LIL.** Chehab, R.; Thiery, Y.; Huebner, K. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1986. 4p. (LAL-RT—86-03; CONF-860629—80). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750265/JAW.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The beam displacement due to misalignment errors of the quadrupoles in the FODO array of the 600 MeV LEP injector Linac (LIL) is simulated using 30 statistically independent sets. The effects of displacement and inclination are compared. Taking into account the random errors in the position measurements, a trajectory correction scheme using small corrector dipoles is tried out on this sample of 30 FODO arrays. It is shown that about five correctors are required to reduce the peak distortion to less than 1 mm at the position monitors. The aperture margin is increased by a factor 10 on average in the most critical places.

4158 **(SAND—87-2344C) RIIM two-pulse injector experiments.** Mazarakis, M.G.; Smith, D.L.; Jones, E.E.; Hasti, D.E.; Jojola, J.M.; Lehmann, M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-8709146—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000926/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The RADLAC-II foilless diode injector was operated under double pulse conditions utilizing the RIIM accelerator as the test bed. The original RIIM accelerator pulse-power network was modified to provide for the generation, transmission, and delivery to the foilless diode of two distinct voltage pulses with variable interpulse separation from 0 to 2 ms. Two pulse-power assemblies were investigated and will be presented in connection with the diode performance. In both cases, the generated plasma and an excessive neutral gas release, following the first pulse, prevented the diode from producing a second beam pulse for interpulse separations larger than ~1 μs. 4 refs.

4159 **(SAND—87-2400C) DELPHI accelerator: Photoconductive switch development.** Zutavern, F.; Loubriel, G.; O'Malley, M.; Blankenship, D.; McKenzie, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-8709146—15). NTIS, PC A02. Order Number DE88001361/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The present design for the DELPHI accelerator demands several high power switches which will close and open (toggle) repetitively at 25 MHz. They must stand off 250 kV and interrupt 5 kA. To meet this requirement, large-scale photoconductive semiconductor switches (PCSS) are being developed. Discussed here are immediate goals and recent results including 82 kV/cm and 2 kA with a single 1 inch diameter by 0.025 inch thick silicon wafer.

4160 **(UCRL—96288) Development of a laced electromagnetic wiggler.** Christensen, T.C.; Burns, M.J.; Deis, G.A.; Parkison, C.D.; Prosnitz, D.; Halbach, K. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 6p. (CONF-870901—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000972/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The laced electromagnetic wiggler is a new concept being developed to attain higher magnetic fields, shorter wavelengths, and larger gaps for the induction-linear accelerator, free-electron-laser (FEL) program. In the laced wiggler design, permanent magnets are located ("laced") between the electromagnetic coils to increase the reverse-bias flux in the iron pole beyond that possible with only pole-edge ("side") permanent magnets. This increase in reverse-bias flux allows wiggler operation at midplane magnetic field intensities comparable to those of a hybrid permanent magnet/steel wiggler, but with field adjustability over a specified range. The maximum field intensity and tuning range are selected, within limits, for specific design requirements. We have designed and tested a one-period prototype of this concept with promising results.

4161 **(UCRL—96289) Development of a strong electromagnet wiggler.** Burns, M.J.; Deis, G.A.; Holmes, R.H.; Van Maren, R.D.; Halbach, K. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 6p. (CONF-870901—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000971/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The Strong Electromagnet (SEM) wiggler is a permanent magnet-assisted electromagnet under development at the Lawrence Livermore National Laboratory (LLNL) as part of the Induction Linac Free-Electron-Laser (IFEL) program. This concept uses permanent magnets within the wiggler to provide a reverse bias flux in the iron and thus delay the onset of magnetic saturation. The electromagnet coils determine the wiggler field and operate at low current densities by virtue of their placement away from the midplane. We describe here the design approach used and test data from a 7-period wiggler prototype that includes curved pole tips to provide wiggle-plane focusing. 7 refs.

4162 **(UCRL—96290) Electromagnetic wiggler technology development at the Lawrence Livermore National Laboratory.** Deis, G.A.; Burns, M.J.; Christensen, T.C.; Coffield, F.E.; Kulke, B.; Prosnitz, D.; Scharlemann, E.T.; Halbach, K. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 7p. (CONF-870901—5). NTIS, PC A02. Order Number DE88000974/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

As a part of the program at the Lawrence Livermore National Laboratory (LLNL) in induction-linac free-electron laser (IFEL) research, we are conducting a variety of activities addressing the unique requirements imposed on IFEL wiggler systems. We are actively developing improved dc iron-core electromagnetic wiggler designs to attain higher peak fields, greater tunability, and lower random error levels. We are pursuing specialized control systems, such as magnetic-field and beam-position controllers, which can relax requirements on the wiggler itself. We are also pursuing basic studies to establish the effect of radiation on permanent magnets.

4163 **(UCRL—96291) The Livermore Free-Electron Laser Program Magnet Test Laboratory.** Burns, M.J.; Kulke, B.; Deis, G.A.; Frye, R.W.; Kallman, J.S.; Ollis, C.W.; Tyler, G.C.; Van Maren, R.D.; Weiss, W.C. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 7p. (CONF-870901—6). NTIS, PC A02. Order Number DE88000973/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The Lawrence Livermore National Laboratory (LLNL) Free-Electron Laser Program Magnet Test Laboratory supports the ongoing development of the Induction Linac Free Electron Laser (IFEL) and uses magnetic field measurement systems that are useful in the testing of long periodic magnetic structures, electron-beam transport magnets, and spectrometer magnets. The major systems described include two computer-controlled, three-axis Hall probe-and-search coil transports with computer-controlled data acquisition; a unique, automated-search coil system used to detect very small inaccuracies in wiggler fields; a nuclear magnetic resonance (NMR)-based Hall probe-calibration facility; and a high-current DC ion source using heavy ions of variable momentum to model the transport of high-energy electrons. Additionally, a high-precision electron-beam-position monitor for use within long wigglers that has a positional resolution of less than 100 μm is under development in the laboratory and will be discussed briefly. Data transfer to LLNL's central computing facility and on-line graphics enable us to analyze large data sets quickly. 3 refs.

4164 (UCRL—96292) **A long electromagnetic wiggler for the paladin free-electron laser experiments.** Deis, G.A.; Harvey, A.R.; Parkison, C.D.; Prosnitz, D.; Rego, J.; Scharlemann, E.T.; Halbach, K. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 6p. (CONF-870901—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000970/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

We have designed, built, and tested a 25.6-m-long wiggler for a free-electron-laser (FEL) experiment. It is a DC iron-core electromagnetic wiggler that incorporates a number of important and unique features. Permanent magnets are used to suppress saturation in the iron and extend the linear operating range. Steering-free excitation allows real-time adjustment of the field taper without causing beam steering. Wiggle-plane focusing is produced by curved pole tips. The magnitude of random pole-to-pole field errors is minimized by a mechanical design concept that reduces tolerance stackup in critical locations. To date, we have tested 15 m of this wiggler, and our measurements have shown exceptionally low levels of random errors. 8 refs.

4165 **H^- formation process in a multicusp ion source.** Leung, K.N.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 7, 787-790(17 Aug 1987). Contract AC03-76SF00098.

The H^- formation process has been investigated in a magnetically filtered multicusp source operated at a modest plasma density. By use of a mixture of xenon and hydrogen gas, it is found that the production of H^- ions in the tandem discharge geometry is consistent with a model of dissociative attachment of low-energy electrons to vibrationally excited hydrogen molecules.

4166 **Positron factory.** Dawson, J.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 194-200(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

The use of the (p,n) reaction in light nuclei is discussed as a source of positrons for a positron factory.(AIP)

4167 **Status of magnet system for RHIC.** Thompson, P.A.; Cottingham, J.; Dahl, P.; Fernow, R.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Hahn, H.; Herrera, J.; and others. (Brookhaven National Laboratory, Upton, NY, 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 371-373(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Specifications for and the design of magnets for the relativistic heavy ion collider (RHIC) at the Brookhaven National Laboratory are discussed in this short talk.

4168 **High energy polarized beams from hyperon decays.** Underwood, D.G. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1161-1165(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The use of various ways to utilize lambda decays to obtain polarized beams of protons and antiprotons is emphasized. Examples described are the Fermilab polarized beam, now under construction, and the use of similar techniques at other energies. Beam transport, spin precession and reversal systems, and polarimeters are also discussed.

4304 Storage Rings

REFER ALSO TO CITATION(S) 4025, 4026, 4094, 4122, 4123, 4126, 4142, 4693, 4734, 5096, 5259

4169 (BNL—52090, pp 31-44) **Summary of working group on storage ring collective effects.** Zisman, M.S. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—). Contract AC03-76SF00098.

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The results of investigations of the influence of collective effects upon the performance of storage ring lattices designed to produce very low emittance beams are presented. Somewhat unconventional lattice types have been explored with the following results: 1) for fixed ring size, wiggler lattices provide lower emittance than conventional designs, and 2) the impedance requirement is more severe for a wiggler lattice with α not equal to 0 than for a conventional lattice. Issues relevant to the $\alpha = 0$ case were also pursued and the results are presented. Finally, based upon standard collective effects, the performance of various conventional lattices has been examined. From these studies it is seen that the damping ring specifications may be achievable, but that the FEL specifications cannot be met without severely compromising the damping time and intensity requirements.

4170 (BNL—52090, pp 45-60) **Conceptual design of a damping ring.** Ruggiero, A.G. (Argonne National Lab., IL). 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—). Contract W-31-109-ENG-38.

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

A very small beam emittance is required for an electron-positron linear collider and for a Free Electron Laser in the hard x-ray range. To achieve the small emittance it has been proposed to make use of Damping Rings where the electron beam at a properly chosen energy would circulate and be cooled by the synchrotron radiation effects. The purpose of this paper is to outline the conceptual design of a Damping Ring. A simple FODO lattice is assumed. Beam and lattice parameters will be given in the thin lens approximation. The beam bunches are stable against coherent oscillations in the microwave region. A relation is developed which connects lattice parameters to the beam parameters. Several applications are shown as well a lattice solution for a preferred set of beam parameters.

4171 (BNL—52090, pp 60-66) **Collider damping ring, Theoretical Minimum Emittance structures.** van Steenbergen, A. 1987. NTIS, PC A11/MF A01. Order Number DE88000133/JAW. (CONF-8703149—).

From ICFA workshop on low emittance e/sup -/ -e/sup +/ beams; Upton, NY, USA (20 Mar 1987).

The objective elementary parameters for the optimum damping ring for a linear colliding system have been given previously. A number of approaches have been pursued elsewhere to obtain damping ring magnet lattice structures with parameters which begin to approach these objective parameters. This included the possible use of a FoDo structure, a Chasman/Green lattice structure and a weak focusing lattice structure with a multiplicity of damping wigglers. In the following, an alternative lattice structure is presented in which the parameters of interest approach quite well the objective parameters. This lattice is designed by applying strictly appropriate lattice boundary conditions as they follow from the theoretical lattice minimum emittance analysis as given as L.C. Teng. In order to present the subject coherently first a few expressions are given summarizing Teng's paper, then the lattice and its parameters are presented followed by the tabulation of the damping ring elementary parameters in comparison with the parameter goals for a colliding beam system damping ring.

4172 **(CERN—87-05) Large Hadron Collider in the LEP tunnel.** Brianti, G.; Huebner, K. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 27 May 1987. 114p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700004/JAW.

The status of the studies for the CERN Large Hadron Collider (LHC) is described. This collider will provide proton-proton collisions with 16 TeV centre-of-mass energy and a luminosity exceeding 10/sup 33/ cm/sup -2/ s/sup -1/ per interaction point. It can be installed in the tunnel of the Large Electron-Positron Storage Ring (LEP) above the LEP elements. It will use superconducting magnets of a novel, compact design, having two horizontally separated channels for the two counter-rotating bunched proton beams, which can collide in a maximum of seven interaction points. Collisions between protons of the LHC and electrons of LEP are also possible with a centre-of-mass energy of up to 1.8 TeV and a luminosity of up to 2 x 10/sup 32/ cm/sup -2/ s/sup -1/.

4173 **(KFK—4188) Microwave diagnostics at the LEAR electron cooler.** Habfast, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Jun 1987. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750160/JAW.

Electron cooling of stored antiprotons is foreseen for the near future at the storage ring LEAR. The optimization of the electron beam can be supported already during development by suitable diagnostics tools. The transverse beam temperature of the electron beam is of big importance for diagnostics, because it strongly influences the cooling performance. It was determined during development and construction of the electron cooler for the first time by microwave diagnostics. The influence of the surrounding vacuum chamber on the emission of synchrotron radiation, which is detected in order to perform the microwave diagnostics, was investigated. Contrary to previous accounts the calculated spectra of synchrotron radiation agree quantitatively with measured ones. The transverse energy of the electron beam could be determined to (0.54+/-0.18) eV. The dependence of the transverse energy on various parameters (bam energy, magnetic field) was investigated quantitatively. Adjustment parameters can be extracted for the installed electron cooling device as well as the developed methods and theoretical models are of use in the construction of further electron cooling devices.

4174 **Nuclear physics with internal targets in electron storage rings.** Holt, R.J. (Argone National Laboratory, Argonne, IL 60439-4843). *AIP (American Institute of Physics) Conference Proceedings;* **161**: No. 1, 138-152(10 Oct 1987). (CONF-8610239—).

From Electron scattering in nuclear and particle science: in commemoration of the 35th anniversary of the Lyman-Hanson-Scott experiment; Urbana, IL, USA (23 Oct 1986).

Two key experiments in nuclear physics will be discussed in order to illustrate the advantages of the internal target method and demonstrate the power of polarization techniques in electron scattering studies. The progress of internal target experiments will be discussed and the technology of internal polarized target development will be reviewed.

4175 **Damping rings for achieving ultra-small electron beam emittance.** Hand, L.N.; Vinson, M.J. (Physics Department, Cornell University, Ithaca, NY). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 462-479(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

A proposal for the use of a storage ring to realize low beam emittance at injection to a TeV linear electron-positron collider is presented. Details of the machine lattices and a description of the computer code used in the simulation are discussed. (AIP)

4176 **Ozone production at NSLS.** Weilandics, C.; Rohrig, N.; Gmur, N.F. (Brookhaven National Lab., Upton, NY 11973). pp 502-511 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC02-76CH00016.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Ozone production by synchrotron radiation as a function of power density in air was investigated using a white beam at the BNL National Synchrotron Light Source (NSLS) x-ray ring. Power densities were calculated from the energy spectrum at 2.52 GeV. Ozone concentrations in small beam pipes were measured for power densities between I = 10/sup 12/ and 10/sup 15/ eV/sup . / cm/sup -3 . /sec/sup -1/. The measured ozone half-life was 37+-2 min. The measured G-value was 2.69+-0.14 mol/100 eV and the ozone destruction factor k was less than 5 x 10/sup -19/cm/sup 3// eV. The random uncertainties stated are approximately one standard error. The large departure of the values for G and k from previous values suggest that some undiscovered systematic error may exist in the experiment. Ozone concentration in excess of the 0.1 ppm ACGIH TLV can be generated in the experimental hutches but can readily be controlled. Industrial hygiene aspects of operation and possible control measures are discussed.

4177 **Aladdin, A 1 GeV storage ring; an opportunity to understand its radiation patterns.** Otte, R.A.; Swanson, W.P.; Rowe, E.M.; De Luca, P.M. (Synchrotron Radiation Center, Univ. of Wisconsin-Madison, 3731 Schneider Drive, Stoughton, WI 53589-3097). pp 479-485 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Aladdin is a 1 GeV electron storage ring funded by the National Science Foundation and operated by the University of Wisconsin-Madison. Its mission is to provide synchrotron radiation for qualified members of the scientific community. A description of the machine will be presented. In the course of its commissioning, a unique opportunity was presented to study the radiation produced by the decay of its stored beam. A simple model was developed to permit calculation of the bremsstrahlung and neutron doses expected from an Aladdin-like storage ring. Results of these calculations are presented. Measurements of the radiation levels produced by the decaying beam are covered in the companion paper.

4178 **Radiation measurements at Aladdin, A 1-GeV electron storage ring.** De Luca, P.M. Jr.; Otte, R.A.; Swanson, W.P.; Schilthelm, S.W.; Rogers, G. (Dept. of Medical Physics, Univ. of Wisconsin-Madison, Madison, WI 53706). pp 486-494 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Bremsstrahlung and neutron radiation levels were measured at the University of Wisconsin Synchrotron Radiation Center (SRC) 1-GeV electron storage ring. Electrons are injected into the ring by a 100-MeV microtron and then accelerated and stored at energies of 0.8 to 1.0 GeV. During accelerator development stored electron currents increased from several mA to a few hundred mA (—4x10/sup 11/). Based upon radiation measurements made with 1-5 mA stored beam and calculations which modeled electron loss patterns, shielding was installed suitable for stored beams of 100-200 mA at 1-GeV electron energy. The intensity and distribution of radiation was measured before, during, and after shielding installation. Measurements were also made of the attenuation of photo-neutrons and forward directed bremsstrahlung in various shielding materials. The results of radiation level measurements for the shielded installa-

tion were consistent with the assumed electron loss model and the observed penetration of bremsstrahlung and fast neutrons.

4179 **Shielding estimates for the conceptual design of the ANL 6 GeV synchrotron light source.** Moe, H.J.; Veluri, V.R.; Wynveen, R.A. (Argonne National Lab., Argonne, IL 60439). pp 549-558 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Bulk shielding was designed for the various components of the proposed 6 GeV Synchrotron Light Source at Argonne. These components include two Linacs, the Positron converter, Booster Synchrotron, and the Main Storage Ring of 800m. The design limits the exposures to 20 mrem/week (occupational) and 25 mrem/y for an individual member of the public. The radiation products considered include high energy neutrons, muons, giant resonance neutrons and Bremsstrahlung. Shielding was estimated for all th components assuming conservative parameters. Details of assumptions, shielding methodology and calculation results are presented.

4180 **Does the transition to chaos determine the dynamic aperture?.** Jowett, J.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 374-377(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00515.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We review the important notion of the dynamic aperture of a storage ring with emphasis on its relation to general ideas of dynamical instability, notably the transition to chaos. Practical approaches to the problem are compared. We suggest a somewhat novel quantitative guide to the old problem of choosing machine tunes based on a heuristic blend of KAM theory and resonance selection rules.

4181 **Microwave instability criterion for overlapped bunches.** Ng, K. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 401-405(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Debunching can be a method to measure Z/n of a storage ring by timing the start of microwave instability. However, if this instability begins to show up when two or more bunches overlap each other, the situation becomes more complex, because one is confused of which local current and energy spread should be used. An analysis shows that exactly the same microwave instability criterion should be used as if there is only one bunch.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 3472, 3519, 4173, 4330, 4704, 4758, 4797, 4898, 5081, 5131, 5143, 5144, 5145, 5333

4182 **(AAEC/E—650) Absolute measurement of the responses of small lithium glass scintillators to gamma radiation.** Dalton, A.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700290/JAW.

The absolute scintillation efficiency and intrinsic resolution of lithium glass scintillators for electron excitation have been determined over a range of electron energies, lithium concentrations and lithium enrichments. Measurements of these response characteristics form part of a study on the possible use of such glasses for the determination of tritium breeding in fusion reactor blanket experiments. The measurements were undertaken to establish a basis for extracting the information relating to tritium production reactions from the background signals induced within the glass scintillators by the neutron/gamma fields of a fusion reactor blanket. Criteria for the selection of glasses most suitable for tritium breeding measurements are discussed in tems of their observed responses.

4183 **(ANL—85-22, pp 114) Energy-loss of heavy ions in targets.** Stephans, G.S.F.; Kovar, D.G.; Vineyard, M.F.; Rehm, K.E. Sep 1985. NTIS, PC A18/MF A01. Order Number DE86002650/JAW.

In Physics Division annual review, 1 April 1984-31 March 1985.

In many experiments involving heavy ions, measured quantities such as velocities of reaction products must be corrected for energy losses in the target in order to obtain the values actually produced in the reaction. Since such corrections can be large, accurate calculations require a reliable energy loss parametrization. In order to test the correction program used in the determination of velocities of evaporation residues produced in fusion of medium weight heavy ions, the Enge split-pole spectrograph was used to measure the energy losses of heavy ions in targets of ^{24}Mg, ^{28}Si, and ^{40}Ca. Beams of ^{16}O, ^{32}S, ^{48}Ti, and ^{58}Ni were used at energies of 0.6, 1.0, and 1.5 MeV/nucleon. A parametrization developed at Argonne and based on the published work of Ziegler was found to reproduce all measured data quite well. This direct check of the energy loss parameterization verifies that target corrections are not a significant source of systematic error in the determinations of evaporation residue velocities in our incomplete fusion studies.

4184 **(BONN-HE—87-13) Transition radiation detectors for electron identification beyond 1 GeV/c.** Appuhn, R.D.; Heinloth, K.; Lange, E.; Oedingen, R.; Schloesser, A. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jul 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750179/JAW.

Transition radiation detectors (TRDs) have been tested for the separation of electrons from pions in the momentum range between 1 GeV/c and 6 GeV/c. Foams as well as fibres and foils served as radiator materials while two types of chambers, a longitudinal drift chamber (DC) and a multiwire proportional chamber (MWPC), both of 16 mm depth and dominantly filled with xenon, were used for detecting the transition radiation photons with a setup of four chambers. Analyzing the data we compared the methods of mean, truncated mean and of maximum likelihood of the total charge measurements and several methods of cluster analysis. As a result of the total charge measurements performed at test beams at CERN and DESY we obtained about 1% pion contamination at 90% electron efficiency for the polypropylene materials in the configuration of four modules with a total length of 40 cm. An improvement by a factor of about two for the electron/pion discrimination can be obtained in case of a detailed analysis of the clusters.

4185 **(CEA-N—2490) Measurement of the polarization of protons and neutrons in the deuterons extracted from Saturne II.** Lehar, F.; Lesquen, A. De; Perrot, F.; Van Rossum, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Jul 1986. 20p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750098/JAW.

We describe the method used to measure the polarization of protons and neutrons in the polarized deuterons accelerated at SATURNE II. The measured nucleon polarization is directly related to the vector polarization of the extracted deuteron beam. The present method is faster than measuring the asymmetry of d-p elastic scattering. From the data accumulated so far, the parameters for on-line calculations are determined in the energy range from 0.8 GeV deuteron kinetic energy up to the maximum energy.

4186 **(CONF-871006—1) A portable measurement system for subcriticality measurements by the Cf-source-driven neutron noise analysis method.** Mihalczo, J.T.; Ragan, G.E.; Blakeman, E.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 2p. NTIS, PC A02. Order Number DE88001413/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A portable measurement system consisting of a personal computer used as a Fourier analyzer and three detection channels (with associated electronics that provide the signals to analog-to-digital (A/D) convertors) has been assembled to measure subcriticality by the ^{252}Cf-source-driven neutron noise analysis method. 8 refs.

4187 **(CONF-871006—3) Data processing and display algorithms for portable instruments.** Alley, G.T.; Bauer, M.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. Order Number DE88001434/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Data processing and display algorithms that have general utility to the processing of statistically poor data and its subsequent presentation on digital or digitally generated analog displays have been developed for microprocessor-based portable radiation instrumentation. By using a modified exponentially weighted filter, the data displayed become easy to interpret in a much shorter amount of time than normally required. The apparent time constant can be dynamically adjusted based on the statistical validity of the data. Related algorithms are used for the simulation of an analog meter movement and handling range changing on digital displays. When used together, these algorithms produce an accurate, stable presentation of data that is also visually pleasing. 4 refs., 2 figs.

4188 **(CONF-871006—9) Some solutions to on-line radiological monitoring of difficult streams.** Bauer, M.L.; Ramsey, J.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001436/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

On-line monitoring for radiological contamination of dirty, but normally not radioactive, streams is difficult. Described are several new, low-fouling units that are intended to replace the existing sensors that monitor both beta and gamma activity. A sensor was designed, using a thin-wall Geiger-Mueller tube for beta and gamma sensitivity, to monitor the influent of the sanitary sewage treatment plant. The new design eliminates dead volumes inherent in the old unit by use of a double-layer, helically wound solenoid made of 5/16-in.-OD thin-wall (0.02-in.) Teflon tubing. A 4-L Marinelli beaker-based system that used a 3 x 3 NaI(Tl) scintillator was replaced with a multilayer solenoid of 5/8-in.-OD Teflon. Two units for the detection of beta radiation are also described. 1 ref., 6 figs., 1 tab.

4189 **(CONF-8707124—1) NBS work on neutron resonance radiography.** Schrack, R.A. (National Bureau of Standards, Washington, DC (USA)). 1987. Contract AI01-86ER40275. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001715/JAW.

From Neutron resonance radiography workshop; Los Alamos, NM, USA (27 Jul 1987).

NBS has been engaged in a wide-ranging program in Neutron Resonance Radiography utilizing both one- and two-dimensional position-sensitive neutron detectors. The ability to perform a position-sensitive assay of up to 16 isotopes in a complex matrix has been demonstrated for a wide variety of sample types, including those with high gamma activity. A major part of the program has been the development and application of the microchannel-plate-based position-sensitive neutron detector. This detector system has high resolution and sensitivity, together with adequate speed of response to be used with neutron time-of-flight techniques. This system has demonstrated the ability to simultaneously image three isotopes in a sample with no interference.

4190 **(CRN-PN—85-18) Contribution to the development study of a personal fast neutron dosemeter using nuclear emulsion.** Ott, C. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Apr 1985. 84p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750096/JAW.

This work deals with the response of a personal neutron dosemeter using nuclear emulsion. The main characteristics of the detector are studied with the help of a computer programme simulating the conditions of the formation of recoil protons tracks recorded by nuclear emulsions. The lecture limits of nuclear emulsions with light microscope and the validity of our computer code are checked by comparing our theoretical values with experimental results.

4191 **(CRN-PN—86-06) Defect detection module.** Ernwein, R.; Westermann, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750260/JAW.

The "defect detector" module is aimed at exceptional event or state recording. Foreseen for voltage presence monitoring on high supply voltage module of drift chambers, its characteristics can also show up the vanishing of supply voltage and take in account transitory fast signals.

4192 **(FRNC-TH—3068) Study and realisation of a microdosimetric detector intended to radioprotection measurement.** Tinelli, P. (Toulouse-3 Univ., 31 (France)). Nov 1986. 207p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750232/JAW.

This work concerns the realisation of a tissue equivalent proportional counter. The detector, which is sensitive to neutron and gamma radiations is intended to measure dose equivalent for radioprotection use. The microdosimetric analysis of the pulses allows us to calculate the absorbed dose and the quality factor, it is possible to discriminate the two kinds of particules. This work is a first step before making an electronical individual dosemeter.

4193 **(GANIL-P—86-23) Achromatic spectrometer Lise at Ganil.** Anne, R.; Bazin, D.; Mueller, A.C.; Jacmart, J.C., Langevin, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750237/JAW.

The achromatic spectrometer Lise installed at Ganil is used for the production and identification of either very neutron or proton rich nuclei obtained in the fragmentation of intermediate energy heavy ion beams at 0 degrees. The characteristics and advantages of the system are described.

4194 **(GSI—87-38-Prepr.) Accelerator mass spectrometry of /sup 41/Ca with a positive-ion source and the UNILAC accelerator.** Steinhof, A.; Henning, W.; Mueller, M.; Roeckl, E.; Schuell, D.; Korschinek, G.; Nolte, E.; Paul, M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.); Hebrew Univ., Jerusalem (Israel)). Jun 1987. 10p. (CONF-8704206—1-Prepr.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750168/JAW.

From 4. international symposium on accelerator mass spectrometry; Rochester, NY, USA (27 Apr 1987).

We have made first tests investigating the performance characteristics of the UNILAC accelerator system at GSI, in order to explore the sensitivity achievable in accelerator mass spectrometry (AMS) of /sup 41/Ca with high-current positive-ion sources. Positively charged Ca/sup 3+/ ions of up to about 100 micro-amperes electrical current were injected from a penning-sputter source and, after further stripping to Ca/sup 9+/, accelerated to 14.3 MeV/nucleon. The combination of velocity-focussing accelerator and magnetic ion-beam transport system completely eliminated background from the other calcium isotopes. Full-stripping and detection of /sup 41/Ca/sup 20+/ ions with a magnetic spectrograph provides separation from isobaric /sup 41/K and, at present, a level of sensitivity of /sup 41/Ca/Ca $\simeq$ 2x10/sup -15/. Future improvements and implications for dating of Pleistoscene samples will be discussed.

4195 **(IAE—4200/2) On a possibility of development of directional reactor antineutrino detector.** Dobrynin, Yu.L.; Mikaehlyan, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700334/JAW.

The schematic diagram of a detector permitting to detect the incident flux direction ν-tilde/sub e/ by recording neutron escape anisotropy in the ν-tilde/sub e/ + p -> n + e/sup +/ reaction is considered. The following system is proposed as a structural model. A plate of hydrogen-coataining material - a CN type scintillator, serves as a target. Positrons inside the plate are detected by /sup 3/He-counter units. Polymethyl methacrylate (C/sub 5/H/sub 8/O/sub 2/, density of 1.18 g/cm/sup 3/) is used as a substance between the /sup 3/He counters. The counter pitch is 6.45 cm, the width between two counter trains is 4.6 cm while the total plate thickness including the counters is 9.2 cm. The counter parameters are as follows: diameter of 3.1 cm, length of 100 cm, counter wall made of 0.05 cm stainless steel, /sup 3/He filling of up to 4 atm. Detector sectionalization results in the deterioration of the correlated background of pair events caused by fast neutrons. 20 refs.; 6 figs.; 2 tabs.

4196 **(IFUSP-P—631) New method to control the on target beam position.** Pereira, D.; Sala, O.; Schnitter, U. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Apr 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700368/JAW.

A method for controlling the incident on-target beam position which utilizes the secondary electrons emitted by the target upon the passage of the beam is presented. It reduces the number of accidental coincidences which enter the detective system thus allowing a better identification of the fusion products. (G.D.F.).

4197 **(IFVE-OEA-OEIPK—86-106) Scanning and measuring peculiarities with high-space resolution objects recorded at the Gabor holograms.** Belokopytov, Yu.A.; Vorob'ev, A.P.; Goncharov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700373/JAW.

Peculiarities of scanning and measurement of Gabor holograms, generated with the NOVS heavy-liquid holographic chamber used as a vertex detector in high energy physics are considered. It is shown that an optical TV scheme with projecting the cross section of the reconstructed three-dimensional image on the TV chamber vidicon and its display on the TV-monitor screen, using subsequently optical and TV magnification may be recommended for processing the events of high spatial resolution recorded on Gabor holograms. A method of precise sighting using measuring cross lines projected on the TV-chamber vidicon is recommended for coordinate measuring in the XY plane parallel to the hologram, a method for the best focusing onto the plane is advisable for z-coordinate measurement. Estimation of the error when determining z-coordinate of a bubble 5 μm in diameter makes up 20 μm at optical magnification equal to 8 and 70 μm at optical magnification equal to 1. 13 refs.; 1 tab.

4198 **(IFVE-OEF—86-62) Beam tests of the DELPHI hadron calorimeter prototype.** Akopdzhanov, G.A.; Bityukov, S.I.; Dzhelyadin, R.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700376/JAW.

The DELPHI hadron calorimeter prototype was tested at IHEP (Serpukhov) in the beam of 9, 25, 40 GeV/c pions and muons. The measured energy resolution of the calorimeter can be parametrized as $\sigma(E)/E=0.03 + 0.8/\sqrt{E}$ (GeV) for 10 GeV/c < E < 40 GeV/c. The influence of material upstream of the calorimeter on the resolution was investigated. The following characteristics were also studied: coordinate resolution, dead space effects; hadron to muon signal ratio; dependence of the calorimeter characteristics on high voltage and electronics threshold. 11 refs.; 18 figs.

4199 **(IFVE-OEIPK—86-55) Data processing system for the K/sup +/p experiment at 70 GeV/c in the BEBC bubble chamber.** Gritsaenko, I.A.; Lugovskij, S.B.; Nikolaenko, V.I.; Petrovykh, L.P.; Petrovykh, Yu.L.; Fenyuk, A.B.; Shlyapnikov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700379/JAW.

The primary data processing system in the K/sup +/p experiment at 70 GeV/c in the BEBC liquid-hydrogen bubble chamber equipped with peripheral electronic detectors: Cherenkov counters and hodoscopes - is described. For examining photographs of events scanning-measurement projectors fitted out with the PDP-8E and DEC-10 computers are used. Restoration of the kinematic track parameters was performed using the geometrical reconstruction program HYDRA-Geometry, kinematic identification of V/sup 0/ particles and allocation of 4C-fit exclusive channels - using the kinematic program HYDRA-Kinematics. For processing of data from the peripheral identifier of secondary charged particles the BERI program is used. The image processing system uses the DACATA system ideology. 22 refs.; 1 fig.

4200 **(IFVE-ORI—86-1) Response functions of the IFK-2,3 and DVS-1 personnel dosemeters in the neutron energy range from thermal one to 5 GeV.** Lebedev, V.N.; Sannikov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700385/JAW.

Response functions of IFK-2, 3 and DVS-1 personnel dosemeters in the neutron energy range from thermal one to 5 GeV have been calculated. Scattered neutrons and secondary charged particles from the human phantom were taken into account in the Monte Carlo program. New values of response of the IFK-2,3 dosemeter to thermal, intermediate and high energy neutrons have been obtained. It is shown, that the DVS-1 personnel dosemeter with MN-3-20 nuclear emulsion, having a high LET threshold, has a good dose-equivalent-response in the wide neutron energy range. The DVC-1 dosemeter satisfies the recent accuracy requirements, as was shown by the analysis of its reponse in different neutron spectra behind the accelerator shielding. 25 refs.; 7 figs.; 3 tabs.

4201 (INIS-mf—10996, pp 51-52) **Simple multiparameter data acquisition system.** Malek, L. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4202 **(INIS-mf—10997) Adaptive system for the quasi-on-line monitoring of radioactive aerosols with a fixed filter equipment.** Mittermayr, H. (Technische Univ., Graz (Austria)). May 1987. 166p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700041/JAW.

Due to the low concentration of aerosols systems which integrate the concentration on a filter must be used. A special computation algorithm was created. Since there are a lot of parameters, which influence the computation of the concentration, its time response has to be optimized for all possible values of the parameters. If all this influencing parameters are also measured it is possible to use an adaptive algorithm, which computes the concentration of radioactive aerosols at any time in an optimal way. This adaptive algorithm was used to design an aerosolmonitor which now works at the Technical University in Graz, Austria. It is also possible to monitor not only the total value of the concentration but also the two most important radioactive aerosols Radium C (Bi 214) and Thorium B (PB 212). Because of the simple hardware of the system this aerosolmonitor does not use the energy information of the radioactive radiation of the aerosols. But if you want to identify each nuclid it is also possible to compute all its concentrations. To do this many energy channals must be evaluated by the discribed algorithm. (Author, shortened by G.Q.).

4203 (INIS-mf—11046, pp 60) **Comparison of quality control parameters of three scintillation cameras measured over a period of one year.** Engelbrecht, J.S.; Geldenhuys, E.M.; Loetter, M.G.; Otto, A.C.; Minnaar, P.C. (University of the Orange Free State, Bloemfontein, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4204 (INIS-mf—11046, pp 53) **Quality assurance program for radiotherapy machines.** Yudelev, M.; Tatcher, M.; Mandelzweig, Y. (Council for Scientific and Industrial Research, Faure, South Africa. National Accelerator Centre; Dept. of Oncology, Rambam Med. Ctr. Haifa, Israel). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4205 (INIS-mf—11046, pp 44) **Radon monitoring with solid-state nuclear track detectors.** Steyn, A.; Strydom, R. (Atomic Energy Corp. of South Africa, Pty Ltd., Pretoria). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4206 (INIS-mf—11046, pp 66) **Interfacing a rectilinear scanner with a personal computer.** Van Rensburg, A.J.; Loetter, M.G.; Minnaar, P.C. (University of the Orange Free State, Bloemfontein, South Africa. Dept. of Biophysics). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4207 (INIS-mf—11046, pp 52) **Calibration of a plane-parallel ionization chamber for the measurement of absorbed doses in electron beams.** Groenewald, W.A. (Tygerberg Hospital, Bellville, South Africa). 1987. (In Afrikaans). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4208 (IPNO-T—84-06) **Memory coincidence system (CALI). Principle and use for the multidetector experiments in nuclear physics.** Pouthas, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France)). 1984. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750476/JAW.

In an experimental set up, the main function of the "CALI system" is to achieve "coincidence" between logic channels. This system also provides a fast selection of the events and their identification by a digital word, and the connection to the data acquisition system.

4209 (IPNO-T—86-02) **Data acquisition and online processing system for experiments on Spes III.** Guillot, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). May 1986. 216p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750475/JAW.

The acquisition phase has been specially taylored to meet the requirements of a modern fast and flexible acquisition system. The data analysis part has the same characteristics but in addition is specially devoted to a precise localisation of the detected particles in the focal plane and an accurate determination of their trajectories. Particular structures of the data ordering have been used to minimize the time necessary to analyse an event so that on line analysis with suitable statistics can be performed.

4210 (ISN—86-69) **Experimental and theoretical study of the proportional blade gaseous detector operation.** Rousset, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1986. 197p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750268/JAW.

The curved gaseous blade detector works in the so called self quenching streamer mode. The electronic signals which are provided are saturated and so insensitive to the radiations's energy which are detected. The systematic study of a gaseous blade detector has been undertaken. Numeric simulation programmes of electronic avalanches have been carried out, showing that a proportional working with such a detector is possible and arises from electrostatic compensations resulting from the blades extension, so far as the gaseous mixture is well selected. The energy resolution that has been experimentally observed is situated between 15% and 30% depending on the blade geometry. On an other hand simulation programmes have predicted space charge effects for avalanches sizes of about 6.10/sup 6/ electrons, and streamers setting for avalanches sizes of about 2.10/sup 7/ electrons. Those calculated values are in good agreement with experimental results.

4211 (JYFL-RR—3/86) **Ion guide method for isotope separator.** Aerje, J. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Jul 1986. 101p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753041/JAW.

A fundamentally new ISOL technique, the ion guide method for isotope separator has been developed. The method is based on thermalization of primary recoil ions from nuclear reactions or radioactive decays in helium and on their transfer by helium flow through a differential pumping system into the accelerating stage of an isotope separator. With this approach, separation times in the submillisecond region are achievable for both volatile and nonvolatile elements. Three main differences between the ion guide and conventional ion sources are emphasized: In the ion guide no ionizers are used, instead natural charge creation mechanisms related to nuclear reactions and radioactive decays are exploited. Secondly, the operation takes place at room temperature and thirdly the simple construction has no wearing components. These properties ensure continuously stable working conditions. The number of recoils per unit reaction cross-section stopped in helium seems to be almost constant in different reactions when equal operating conditions are used. The overall separation efficiencies measured for heavy nuclided induced in light ion reactions are up to 10%. The shortest lived activity identified in an on-line separation is the 182 μs isomeric state of "2"0"7Bi.

4212 (LAL-RT—87-04) **VAX-FPS Loosely-Coupled Array of Processors.** Grosdidier, G. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 8p. (CONF-870249—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750485/JAW.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The main features of a VAX-FPS Loosely-Coupled Array of Processors (LCAP) set-up and the implementation of a High Energy Physics tracking program for off-line purposes will be described. This LCAP consists of a VAX 11/750 host and two FPS 64 bit attached processors. Before analyzing the performances of this LCAP, its characteristics will be outlined, especially from a user's point of vue, and will be briefly compared to those of the IBM-FPS LCAP.

4213 (LPC—85-19) **Precise error propagation from detector measurements to charged tracks parameters in simulation studies.** Billoir, P. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752718/JAW.

A direct numerical algorithm (without Monte-Carlo evaluation) is proposed to compute the error matrices on optimal estima-

tor of trajectory parameters in a track detector, assuming Gaussian errors on the raw measurements, and including, if needed, the effect of multiple scattering. Approximations are given for the case of helix trajectories.

4214 **(LPNHE—86-04) Time-of-flight of Cello.** Rivoal, M.; George, R. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies). Mar 1986. 57p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750477/JAW.

Time-of-flight counters of Cello detector are described. The time-of-flight system with allow a best rejection of cosmic radiation, a slow proton recognition and a calibration of the central detector. The time-of-flight counters give triggering on cosmics allowing the calibration of stereo wire chambers of the new central detector.

4215 **(LYCEN-TH—8628) Prototype study of a BGO electromagnetic calorimeter for the experiment L3.** El Mamouni, H. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1986. 153p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750497/JAW.

The L3 experiment detector at LEP is equipped with an original electromagnetic calorimeter. Such a calorimeter is made of a new calorimetric material, viz, Bismuth Germanate Oxyde (BGO). Furthermore, the scintillation light is read by means of large-area photodiodes. The latter choice for the photodiodes is dictated by the presence of a magnetic field. This thesis deals with the study in the 1-50 GeV energy range of the performances of a prototype for this new calorimeter. A great deal of efforts is devoted to ameliorate the energy resolution by improving the signal/noise ratio, the BGO crystals quality, the wrapping, the mechanical structure, etc... The goodness and the quality of the obtained results (concerning the linearity, the energy resolution and the position resolution) make it possible to reach in the near future the stage of the construction of a definitive calorimeter.

4216 **(MPI-PAE/Exp.El.—173) Correlated noise in silicon strip detector readout.** Lutz, G. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Feb 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750157/JAW.

Noise correlation due to interstrip capacitances plays an important role in silicon strip detector readout. This is especially true for readout with directly bonded integrated electronics as, due to avoidance of the fanout and connected ground capacitances, interstrip capacitances dominate the capacitive load at the amplifier input. Consequences of this fact on energy and position measurement precision are calculated and guides for an optimal choice of the readout pitch are given.

4217 (OUP—86-28, pp 278-299) **Low light level measurements with photomultiplier tubes. Photon counting versus electrometer operation.** Wright, A.G. (Thorn EMI Ltd., Hayes, UK. Central Research Labs.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The intensity of light falling on a photomultiplier may be estimated by using either a current measuring techniques, or by employing the photon counting methods. In both cases the photomultiplier noise-in-signal dictates the ultimate sensitivity attainable. Where very low light levels are involved, photon counting offers optimum sensitivity. Considerations relevant to the selection of suitable photomultiplier are: Spectral response, dark current, dark count, and single electron resolution capability. Guidance on setting up a system for low light level measurements is given.

4218 (OUP—86-28, pp 300-310) **Pulse amplifier/discriminator (PAD) for single photon counting.** Alexander, L. (Stockholm Univ., Sweden. Dept. of Meteorology). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The LeCroy MVL 100 pulse amplifier/discriminator (PAD) has been evaluated for use in single photon counting. The following properties have been studied: Count rate (N) as a function of photon flux (PHI) when used with an EMI 9924B photomultiplier; pulse pair resolution time; power requirements; and necessary additional components. The pulse amplifier has been found to be reliable, fast, and small. The circuit diagram and the printed circuit board layout are shown.

4219 **(PCCF-T—85-08) Performance study of a prototype of an electromagnetic calorimeter from Aleph: Signature of electrons and rejection of pions.** Prat-Martinez, J. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Nov 1985. 93p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750105/JAW.

We have analysed data taken with a prototype of the ALEPH electromagnetic calorimeter. The aim of this work was to find criteria to obtain the lowest value of the π/e rejection coefficient with a good efficiency to the electrons. At the same time we have measured the energy resolution and the spatial resolution of our apparatus. The experimental results were compared with the predictions of the simulation programs: EGS for the electromagnetic showers and GHEISHA for the hadronic one's.

4220 **(RAL—87-019) Charge sensitive pre-amplifier used for photo-triode readout in the OPAL lead glass detector.** Stephenson, R. (Rutherford Appleton Lab., Chilton (UK)). Mar 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750205/JAW.

The report describes the preamplifiers which have been developed specifically to process the signals from the vacuum phototriodes used on the OPAL experiment at CERN. It outlines the design philosophy, describes the chosen circuit arrangement and includes performance test data. It includes details of the surface mount manufacturing process used for the 2264 production amplifiers, and describes the automated acceptance testing system used to individually check their performance.

4221 **(RAL—87-033) High resolution scintillating fibre (SCIFI) tracking device with CCD readout.** Atkinson, M.N.; Crennell, D.J.; Fisher, C.M.; Hughes, P.T.; Kirkby, J.; Fent, J.; Freund, P.; Osthoff, A.; Pretzl, K. (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750647/JAW.

Submitted to Nuclear Instruments and Methods.

The authors present initial test beam measurements of a high resolution scintillating fibre detector with charge coupled device readout. The analysis procedure is discussed and the performance of the detector and its readout assembly is evaluated. A detected photon density is found along minimum ionising tracks of 2.0 mm^{-1}, with a straight-line RMS residual of 19.3 +- 2.9 μm, giving rise to a track impact parameter precision of 8.8 +- 2.0 μm. The two-track resolution is found to be 52 μm.

4222 **(RAL—87-047) Polarised neutron reflectometer for studying surface magnetism.** Felici, R.; Penfold, J.; Ward, R.C.; Williams, W.G. (Rutherford Appleton Lab., Chilton (UK)). Jul 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750648/JAW.

A polarised neutron reflectometer for studying surface magnetism is described. Its application to problems in surface magnetism is discussed, and its potential is illustrated by some recent results on the magnetisation of thin nickel and cobalt films.

4223 **Lithium-free scintillation glasses for fast-neutron detection.** Smith, J.R.; Fisher, R.K.; Leffler, J.S. (GA Technologies Inc., San Diego, California 92138). *Review of Scientific Instruments;* **58**: No. 10, 1905-1909(Oct 1987).

In this article, we present observed characteristics of new lithium-free scintillation glasses which have been developed to make time-resolved measurements of the 14-MeV neutron flux from deuterium plasmas. These measurements will yield information on

the burnup of tritons in today's deuterium plasmas and are needed to better predict the confinement and slowdown of alpha particles in future D—T burning plasmas. The new glasses were formulated to have good detection efficiency for 14-MeV neutrons, and yet be insensitive to 2.5-MeV and lower-energy neutrons. The glass response to alpha, gamma, and neutron radiation is shown. The intrinsic neutron detection efficiency of the scintillation glass is seen to increase significantly as a function of neutron energy, providing the necessary discrimination against low-energy neutrons. We discuss the reactions which determine the glass neutron response and suggest that this response is dominated at higher neutron energies by gamma rays created by neutrons inelastically scattering from oxygen present in the glass. For high-energy neutron detection in the presence of excessive background gamma radiation, we discuss a new coincidence configuration of lithium-free scintillation glass with NE213 liquid scintillator.

4224 **A portable X-ray spectrometer/dosimeter based on a silicon diode.** Eisen, Y.; Olsher, R.H.; Brake, R.J.; Littlejohn, G.J.; Meddles, A. (Los Alamos National Lab., Los Alamos, NM 87545). pp 161-170 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The author developed a portable x-ray spectrometer/dosimeter based on a silicon p-i-n diode. The instrument is capable of obtaining spectral information in the region from 18 keV to 150 keV and measuring photon exposures in the region from 18 keV to 1.3 MeV. A theoretical method is described for obtaining a nearly air-equivalent response in the energy region above 18 keV. The instrument has a dynamic range for most energies between 0.5 mR/h and 5 R/h. Its small size, ability to provide spectroscopic output, and satisfactory air-equivalent response over a wide energy range make this instrument more attractive than portable ionization chambers.

4225 **Status of the Soudan 2 nucleon decay experiment.** May, E.N.; For the Soudan 2 Collaboration. (Argonne National Laboratory, Argonne, Illinois 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1134-1136(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Soudan 2 is an 1100-ton fine-grained tracking calorimeter now being constructed to search for nucleon decay. It is distinguished by superior background rejection for a wide variety of decay modes and by a trigger threshold low enough for 100 MeV neutrino-induced muons. A new laboratory large enough for an eventual 3300 ton experiment has been constructed in Minnesota's Soudan mine at a depth equivalent to 2200 meters of water. The detector will be assembled from 256 5-ton calorimeter modules, utilizing corrugated steel sheets and plastic drift tubes to obtain a rather isotropic honeycomb geometry. Data collection will begin in the fall of 1986 and assembly of the 1100 tons will be completed in 1988. Installation progress and the performance of the first 5-ton modules will be described.

4226 **Readout and triggering of the Soudan 2 nucleon decay experiment.** Thron, J.L. (Argonne National Lab.). pp 375-376 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The readout and triggering electronics for the Soudan 2 proton decay detector is characterized by its versatility and the large number of identical channels. The versatility will enable one to trigger on many types of events, even unexpected phenomena, and the large number of channels gives very cheap unit prices. There will be a total of — 50,000 preamps for the anode and cathode signals. These will be bussed in groups of 8, giving 6144 channels for pulse height digitization and triggering. This electronics is packaged with 16 channels on each ADC card in Multibus format crates.

4227 **Performance of the CDF central electromagnetic calorimetry.** Schoessow, P.; Barnes, V.; Bertolucci, S.; Burley, W.; Chadwick, K.; Cihangir, S.; Connor, D.; Cooper, J.; Diebold, R.; Elias, J. (Argonne National Lab.). pp 366 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The central electromagnetic calorimetry for the collider detector at Fermilab (CDF) consists of 48 modules, each one a lead-scintillator stack with a total thickness of 19 radiation lengths. A PWC with cathode strips is embedded in each stack at a depth of 6 radiation lengths to provide a measurement of shower position. Results from a prototype have been published previously. Production modules use SCSN-38 polystyrene scintillator and Y7 wavelength shifter. The production modules, as expected, perform slightly better than the prototype.

4228 **Calibration of the CDF central electromagnetic calorimetry.** Hahn, S.; Barnes, V.; Bertolucci, S.; Burley, W.; Chadwick, K.; Cihangir, S.; Connor, D.; Cooper, J.; Diebold, R.; Elias, J. (Univ. of Pennsylvania). pp 365 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The central region of the Colliding Detector at Fermilab is composed of 48 wedges, each with 19 radiation lengths of lead-scintillator stack divided into ten towers of equal azimuth and pseudorapidity. Wave shifters and light guides transmit the light from th scintillator to the phototubes. Fourteen wedges have been scanned in a test beam with 50 GeV electrons.

4229 **Construction and operation of a drift-collection calorimeter.** Ambats, I.; Ayres, D.S.; Dawson, J.W.; Hoftiezer, J.H.; Joyce, T.H.; Mann, W.A.; May, E.N.; Pearson, N.M.; Price, L.E.; Sivaprasad, K. (Argonne National Lab.). pp 367 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Large area planar drift chambers with long drift distances (up to 50 cm) have been developed for possible use in the new Soudan 2 nucleon decay detector. Design goals included fine sampling to determine the topology of complex events with several low-energy tracks. The large scale of the experiment (> 1000 metric tons) required large area, inexpensive chambers, which also had good position resolution and multi-track separation. Chamber construction is illustrated. A prototype calorimeter was assembled from 50 drift chambers interleaved with 3 mm thick steel sheets. The performance of the device was studied in a low-energy charged particle test beam, tagged by time of flight. An orthogonal two-dimensional readout was obtained from the prototype array by reading out individually each anode wire, bussing corresponding cathode pads from chamber to chamber and reading out each of the cathode busses. Particle identification ability of the detector is illustrated by representative event displays (at 300 MeV/c) of a muon, a pion and an electron.

4230 **Calibration with cosmic ray neutrinos.** Gaisser, T.K.; Stanev, T. (Bartol Research Foundation of the Franklin Institute, University of Delaware, Newark, DE 19716). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 89-97(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

We discuss how the angular dependence of the cosmic ray neutrinos at various sites can be used for calibration of nucleon decay detectors.

4231 **Monopole search and neutrino astrophysics with liquid scintillation detectors.** Brown, K.; Cherry, M.L.; Corbato, S.; Davidson, I.; Keida, D.; Lande, K.; Lee, C.K.; Steinberg, R.I. (University of Pennsylvania, Philadelphia, PA 19104). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 136-153(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

We describe the 140 ton Large Area Scintillations Detector now nearing completion in the Homestake Mine and our plans for a one kiloton liquid scintillation solar neutrino detector.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

4232 **(UCRL—95052) Current status of high power microwave effects and simulation.** Cabayan, H.S. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 9p. (CONF-861240—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87004112/JAW.

From 3. national conference on high power microwave technology for defense applications; Albuquerque, NM, USA (1 Dec 1986).

This article is based in part on the findings of the HPM Effects Panel. The findings of the panel have been reported elsewhere, and are summarized here. Issues that are covered include potential upper bounds of the fluences from HPM weapons, the phenomenology of HPM system effects, critical issues in HPM system effects simulation and HPM simulation requirements.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 2790, 3070, 3360, 3453, 3647, 3648, 3800, 3802, 4623

4233 **(AD-A—183650/1/XAB) Fourier-transform ion-cyclotron-resonance mass spectrometry at low magnetic fields: several figures of merit. Technical report, January 1985-September 1986.** Hearn, B.A.; Baykut, G.; Eyler, J.R. (Florida Univ., Gainesville (USA). Dept. of Chemistry). 29 Jul 1987. 20p. (TR—11). NTIS, PC A02/MF A01.

A Fourier-transform ion-cyclotron-resonance mass spectrometer based on a permanent magnet with a magnetic induction of 0.16 T with low homogeneity provided a precision of 3.2% (taken as the relative standard deviation of the hourly mean of three independent measurements) over a 5 hour period and a precision of 11.7% for daily measurements over a 10-day period. For the permanent-magnet system, resolution values for perdeuterated benzene (m z 84) for a given mass range and a given number of data points were similar to those measured for both an electromagnet (0.2 to 1.0 T) and a superconducting solenoid (3.0 T). Signal-to-noise ratios for perdeuterated benzene obtained with the three different magnets were also measured.

4234 **(CEA-CONF—8925) Temperature measurement in nuclear environment.** Degas, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Dec 1986. 15p. (In French). (CONF-8612109—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750079/JAW.

From Workshop on temperature measurements; Paris, France (16 Dec 1986).

Some criterions, that the used sensors have to follow, are given together with the conditions they may encountered. They may be used in irradiation or safety test devices, in experiments concerning mock-up or plant element, or even in nuclear plants themselves. The most suitable sensor type are mentioned, with their characteristics and their fiability. Two use examples of temperature probes are given, chosen to illustrate two sensor types: thermocouples in Superphenix-1 and platinum resistance probes in research reactor Orphee.

4235 **(CONF-870610—13) Area detectors for x-ray spectroscopy.** Callcott, T.A.; Tsang, King-Long; Zhang, Cheng Heng; Ederer, D.L.; Arakawa, E.T. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); National Bureau of Standards, Washington, DC (USA)). Jun 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001429/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

Area detectors greatly increase the efficiency of data acquisition in spectroscopic applications. The operating principles, advantages and limitations of two types of detector systems are described. They are the microchannel plate (MCP) with resistive anode readout, and the silicon charged-coupled-device (CCD), both with and without MCP enhancement. The linearity, size, resolution, quantum efficiency, noise specifications, stability, and uniformity of response are discussed. Data acquisition electronics are described briefly. The use of the devices is illustrated with applications to electron and soft x-ray spectroscopy.

4236 **(CONF-8708110—21) Streak tube characterization for transient recording.** Jennings, T.B.; Olsen, R.W. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations; EG and G Energy Measurements, Inc., Pleasanton, CA (USA). Amador Valley Operations). 1987. Contract AC08-83NV10282. 7p. NTIS, PC A02. Order Number DE88000957/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

This paper describes the methods used by EG and G Energy Measurements to characterize a streak tube. Both radiometric (QE, uniformity, gain, linearity, extinction ratio, opacity) and resolution (static, spatial, and temporal) tests are covered. The significance of these measurements with respect to streak camera applications is discussed. The results of the measurements on a streak tube designed and built by EG and G Amador Valley Operations are included as an illustration. 6 refs.

4237 **(EGG-M—20587) Flame spectral analysis for boiler control.** Metcalfe, C.I.; Cole, W.E.; Batra, S.K. (TECOGEN, Inc., Waltham, MA (USA)). Sep 1987. Contract AC07-76ID01570. 6p. (CONF-8709166—1). NTIS, PC A02. Order Number DE87014877/JAW.

From Annual industry and technology conference; College Station, TX, USA (16 Sep 1987).

An instrument has been developed by Tecogen, Inc., to determine the combustion characteristics of individual burners in multiburner installations. The technology is based on measuring the emissions in the ultraviolet (uv) and infrared (ir) spectral range from the flames and using these measurements to determine the burner operating conditions. Two prototype instruments have been installed on package boilers at a Con Edison powerplant and a Polaroid facility, and their performance has been evaluated. These instruments provide data relating to the variations in the ir and uv spectrum with a change in the combustion condition in individual burners. This paper describes the instrument's operation and these tests. 2 refs.

4238 **(FRNC-TH—3056) Contribution to nuclear magnetic resonance imager using permanent magnets.** Schuster, P. (Institut National Polytechnique, 38 - Grenoble (France)). Jul 1986. 199p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750266/JAW.

After some recalls of nuclear magnetic resonance, ways to get a stable and homogeneous magnetic field are studied with permanent magnets. Development of correction coils on integrated circuits has been particularly stressed. Gradient coil specific systems have been studied taking in account ferromagnetic material presence. Antenna system has been improved and possibility of image obtention with the prototype realized has been shown.

4239 **(IAE—4328/15) System for data recording and processing in the 3 cm automated EPR spectrometer.** Pastukhov, A.N.; Suraev, V.V.; Rutkovskij, I.Z.; Schastnyj, V.V.; Tarasevich, A.D.; Fedoruk, G.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700353/JAW.

System for signal recording and preliminary processing in the 3cm automated EPR spectrometer aimed at investigation of atomic state hydrogen using multichannel digital memory is described. It permits to carry out modulational and "modulational-free" recording of EPR signals, to study kinetics of observable processes using amplitude-time measurement conditions, spin echo investigation of the relaxation processes. 8 refs.

4240 **(IFVE-OEA—86-105) Development and study of fibre-optic link lines on the basis of the KEM-8-4PD, KEM-8-4PR quantum-electronic modules.** Bojko, I.B.; Bojko, M.V.; Gerasimov, B.Ya.; Detinenko, N.E.; Pilipenko, S.I.; Tokarev, S.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700372/JAW.

The method of adjustment of the cable part of optical demontable connectors using the non-precise eccentric elements, the method of extending optical cables several kilometers long with splice machine's aid, the technical means to evaluate the elements of fibre-optic link lines (FOLL) are described. The example of the FOLL application on the basis of KEM-8-4PD for synchropulses transmission to control of the preinjector of the I-100 linear accelerator is given. 11 refs.; 5 figs.; 2 tabs.

4241 **(LA-UR—87-3575) A segmented calorimeter for low-energy particle beams in space.** Barron, M.H.; Gallagher, T.O.; Goulding, C.A.; Hedges, R.O.; Henneke, K.M.; Moss, C.E.; Shrouf, K.C.; Slentz, G.E. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 4p. (CONF-871006—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001806/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

We describe a segmented calorimeter for determining the spatial intensity distribution of a neutral particle beam. Our instrument for a 1-MeV H^0 beam consists of a 5 x 5 array of boron nitride (BN) blocks, each block 0.975 cm by 0.975 cm by 0.053 cm thick, glued onto a polyimide printed circuit board. The temperature sensor behind each block is a special integrated circuit (AD590). The sensor data are multiplexed into an IBM AT computer for laboratory testing or into a telemetry system and a microVAX II computer for flight. Special features include protection against beam-induced sparking and the launch and space environment.

4242 (OUP—86-28, pp 364-370) **Calibration photometer for low brightness sources.** Lauche, H.; Barke, W. (Max-Planck-Institut fuer Aeronomie, Katlenburg-Lindau Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

4243 (OUP—86-28, pp 384) **Canadian meridian photometer array (CANOPUS MPS).** McEwen, D.J.; Cogger, L.; Creutzberg, F.; Gattinger, R.; Harris, F.; Jones, A.V.; Koehler, R.A.; Wolfe, J. (Saskatchewan Univ., Saskatoon, Canada. Inst. of Space and Atmospheric Studies). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

4244 **(PB—87-227625/XAB) NBS (National Bureau of Standards) measurement services: radiometric standards in the vacuum ultraviolet. Final report.** Klose, J.Z.; Bridges, J.M.; Ott, W.R. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jun 1987. 140p. (NBS/SP—250/3). NTIS, PC A07/MF A01.

Also available from Supt. of Docs as SN003-003-02806-1. See also PB—87-174041; Library of Congress catalog card no. 87-619833.

The radiometric calibration program carried out by the vacuum-ultraviolet radiometry group in the Atomic and Plasma Radiation Division of the National Bureau of Standards is presented in detail. The calibration services are first listed, followed by descriptions of the primary standards, which are the hydrogen arc and the blackbody line arc, and the secondary standards, which are the argon mini- and maxi-arcs and the deuterium arc lamp. Next, the calibration methods involving both spectral radiance and irradiance are discussed along with their uncertainties. Finally, the intercomparison of standards as a method of quality control is described.

4245 **(SAND—87-2339C) Sensing in liquids using acoustic plate mode devices.** Martin, S.J.; Ricco, A.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-871220—2). NTIS, PC A02. Order Number DE88000741/JAW.

From Institute of Electrical and Electronics Engineering international electron devices meeting; Washington, DC, USA (6 Dec 1987).

Acoustic plate mode devices fabricated on ST-quartz and operating at 158 MHz have been used to measure both liquid viscosity and changes in surface mass caused by accumulation of species from a liquid. A new model is proposed to explain the observed perturbation in plate mode propagation characteristics caused by viscous coupling of liquids and by mass accumulation at the solid/liquid interface. Measurements confirm the dependence of plate mode attenuation on the square root of viscosity and of velocity perturbation on surface mass density. 9 refs., 4 figs.

4246 **(UCID—21154) Model development for induction heating.** Gresho, P.M. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002376/JAW.

The simulation tools for modeling the fluid mechanics in the melt and the heat transfer in and around the melt, while far more complex than that required to determine the power input to the crucible, will be subjects of other reports. Herein we focus on the single question: what is the spatial (and temporal if relevant) distribution of power generation in the metal crucible? 12 refs.

4247 **(UCRL—15970) Silicon microscale mechanisms from (110) oriented wafers.** Ciarlo, D.R. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1987. Contract W-7405-ENG-48. 31p. (R—86-044). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002096/JAW.

We have studied the use of (110) oriented silicon wafers for the fabrication of cantilever type accelerometers. Using this orientation, canilevers can be fabricated such that their thickness is in a direction parallel to the wafer surface, and their width is equal to the wafer thickness. With such a design, the cantilevers deflect in a direction parallel to the wafer surface instead of perpendicular to the surface, as is the case with cantilevers fabricated from (100) oriented wafers. It might be possible to fabricate structures such as setback accelerometers and latching mechanisms with (110) silicon cantilevers. We have designed and fabricated corner compensation structure for use with (110) oriented cantilevers. 8 refs., 23 figs.

4248 **(UCRL—96920) Characterization of a large-format, high-fidelity, picosecond, optical streak camera.** Lowry, M.; Lancaster, G.; Jander, D.; Grasz, E.; Simpson, B.; Lerche, R.; Rickard, B.; Imhoff, C. (Lawrence Livermore National Lab., CA (USA); Test and Measurement Systems, Inc., Santa Clara, CA (USA); Compagnie Generale de Telegraphie Sans Fil (CSF), 75 - Paris (France)). 12 Oct 1987. Contract W-7405-ENG-48. 8p. (CONF-8708110—25). NTIS, PC A02. Order Number DE88001594/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

We have completed preliminary characterizations of a new 3-grid, large-format, ITT streak camera tube operating with about a 2.3-kV extraction voltage. We have found that the best attainable impulse response is ~10 ps at low input intensity. However, the impulse response increases to only 30 ps with an increase of nearly three orders of magnitude in input intensity. Further, the spatial resolution remains greater that 5 line pairs/mm at 50% contrast over these three orders of magnitude of input intensity. We have also done preliminary computational modeling of the tube's temporal response as a function of focus voltage, illumination spot size, and wavelength. 8 refs.

4249 **(Y/DK—544) Hydrogen detectability in uranium by U N/sub VI/O/sub IV/ peak shift.** Thompson, K.A.; Walker, L.R. (Oak Ridge Y-12 Plant, TN (USA)). 30 Jan 1987. Contract AC05-84OS21400. 11p. (CONF-870725—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001821/JAW.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

A distinct shift in the uranium N/sub VI/O/sub IV/ x-ray line has been observed for several light elements (including hydrogen) bonded to uranium. Elements above beryllium in atomic number can be directly detected from their own x-ray emission lines, whereas hydrogen can only be detected indirectly by secondary effects. This allows for a promising method of detecting hydrogen in materials that have soft x-ray lines from orbitals that are involved in chemical bonding. Other effects, such as crystal orientation, purity of standards, and spectrometer reproducibility, also must be considered; each of these considerations is discussed in detail.

4250 **Channel electron multiplier compatibility with Viton and Apiezon-L vacuum grease.** McComas, D.J.; Baldonado, J.R.; Bame, S.J.; Barraclough, B.L. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **58**: No. 12, 2331-2332(Dec 1987).

Clean Viton and Viton coated with Apiezon-L vacuum grease were tested for their noncontaminating compatibility with channel electron multipliers (CEMs). The test setup and procedure were the same as those used previously in conjunction with CEM compatibility tests of certain epoxies, solder, and fluorocarbon polymer materials useful for construction of spaceflight sensors. While some CEM gain degradation was noted during exposure to Viton and Apiezon-L, the present tests indicate that, at least over instrument lifetimes of ~2 x 10^{12} counts, these materials should be suitable for (1) preflight space sensor testing systems, (2) hermetic seals for CEM-based space sensors, and (3) terrestrial CEM-based instrumentation.

4251 **Stressed photoconductive detector for far-infrared space applications.** Wang, J.h.; Richards, P.L.; Beeman, J.W.; Haller, E.E. (University of California, Berkeley, California, 94720). *Applied Optics;* **26**: No. 22, 4767-4771(15 Nov 1987).

An optimized leaf-spring apparatus for applying uniaxial stress to Ge:Ga far-infrared photoconductor has been designed and tested. This design has significant advantages for space applications which require high quantum efficiency and stable operation over long periods of time. The important features include adequate spring deflection with relatively small overall size, torque-free stress, easy measurement of applied stress, and a detector configuration with high responsivity. One-dimensional arrays of stressed photocondutors an be construced using the design. A peak responsivity of 38 A/W is achieved in a detector with a cutoff wavelength of 200 μm, which was operated at a temperature of 2.0 K and a bias voltage equal to one half of the breakdown voltage.

4252 **Elimination of the induced current error in magnetometers using superconducting flux transformers.** Dummer, D.; Weyhmann, W. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Review of Scientific Instruments;* **58**: No. 10, 1933-1936(Oct 1987).

The changing magnetization of a sample in a superconducting flux transformer coupled magnetometer induces a current in the transformer which in turn changes the field at the sample. This "image" field and the error caused by it can be eliminated by sensing the current in the loop and nulling it by feedback through a mutual inductance. We have tested the technique on the superconducting transition of indium in an applied magnetic field and shown that the observed width of the transition is greatly reduced by maintaining zero current in the flux transformer.

4253 **Raman spectroscopy applictions of an imaging photomultiplier tube.** Veirs, D.K.; Chia, V.K.F.; Rosenblatt, G.M. (Lawrence Berkeley Laboratory, Materials & Molecular Research Division, Berkeley, California 94720). *Applied Optics;* **26**: No. 17, 3530-3535(1 Sep 1987). Contract AC03-76SF00098.

A Raman spectroscopy system having an unprecedented combination of high sensitivity and low noise has been built incorporating an imaging (2-D) photomulipler tube. The number of photons detected for a vibrational band approaches the theoretical limit set by the Raman cross section and experimental configuration. A detector dark count of 10^{-4} counts/s/pixel is the major electronic source of noise. The spectrum of air reveals low concentration gas components, specifically $^{16}O^{18}O$ and CO_2. Vibrational Raman spectra are obtained from solid samples as thin as 20 nm low laser powers, e.g., 6.5 mW. The imaging photomultiplier yields 1-D (along the focused laser beam) Raman images of interfaces or concentration gradients.

45 EXPLOSIONS AND EXPLOSIVES

4254 **(SAND—87-0784) Langlie Test Method Program for use with the HP-41CV/X calculator.** Kopczewski, M.R. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001935/JAW.

Explosive component designers need to test the sensitivity of some unit response as a function level of stress, for example, the sensitivity of a detonator or ignitor bridgewire to input current. There exists a threshold level, above which the detonator will function and below which it will not. Statistical testing of explosive components often requires destructive testing of expensive hardware. If the unit functions, it is destroyed; and if it doesn't fire, the results from any further testing cannot be relied on because the initial test affects the detonator. In order to obtain meaningful results and not expend a large number of units, the Langlie "One-Shot" Method of testing is employed. Typical component attributes that require Langlie testing include "all-fire" and "no-fire" tests to determine threshold levels of performance. Generally, any sensitivity testing lends itself to the Langlie method. This method has also been shown to be insensitive to design. Typically, support test groups and venders implement the test method with their own computers. The method is subject to some interpretation which may lead to inconsistency in results from facility to facility. Another concern is that an error made in choosing a stimulus level will affect subsequent levels, resulting in an analysis that is not a true Langlie. A program has been written for the HP-41CV/X calculator in order to standardize the Langlie test procedures at the various facilities, and to minimize the possibilities of introducing errors in the test method. A distinct advantage of using the calculator is the ability to hand carry it in the field and perform the Langlie test method at remote locations. 2 refs.

4255 **Motion of a plate driven by an explosive.** Fickett, W. (Mail Stop P952, Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Journal of Applied Physics;* 62: No. 12, 4945-4946(15 Dec 1987).

In many applications it is useful to have an estimate of the velocity of a metal plate driven by an explosive as a function of time. With reasonable approximations, this problem has been solved exactly, but the result takes the form of a parametric solution, not the most convenient for everyday use. We give a simpler explicit solution and graphs plotted in variables suitable for accurate reading.

4501 Chemical

4256 **(SRD/HSE/R—412) Feasibility study of the assessment of risks involved in the conveyance of explosives by road.** Chapman, H.; Holden, P.L. (UKAEA Safety and Reliability Directorate, Culcheth). Apr 1987. 47p. United Kingdom Energy Authority, Wigshaw Lane, Culcheth, WA3 4NE. Order Number TI88900113/JAW.

This report studies the feasibility of the assessment of risks involved during the conveyance of explosives by road. It highlights the differences between 5 te loads conveyed by traditional means and 16 te loads which are conveyed in freight containers. In particular it has identified the hazardous situations that can arise and the mechanisms by which they might occur. The application of risk assessment techniques to these hazardous situations has been investigated wherever possible and the information requirements to carry out such an assessment have been specified. 20 refs., 12 figs., 5 tabs.

4502 Nuclear

REFER ALSO TO CITATION(S) 4595, 4602

4257 **(AD-A—183805/1/XAB) Wildland fires and nuclear winters. Selected reconstruction of historic large fires. Technical report, 1 March 1985-28 February 1986.** Pyne, S.J.; Omi, P.N. (Iowa Univ., Iowa City (USA). Dept. of History). 28 Feb 1986. 174p. NTIS, PC A08/MF A01.

Under the nuclear winter scenario, large wildland fires are expected to contribute to a general smoke plume and are considered potential analogues for the behavior of gigantic palls. As a means of testing the reasonableness of current estimates of a wildland fire contribution, the authors reconstructed from the historic record two major events; the Tillamook Burn of August 1933 and the 1910 fire complex in the Northern Rocky Mountains. Both events are near the upper limit for wildland fires - the Tillamook Burn for a single fire. For the 1910 fires, for which environmental data are skimpy, a modern analogue, the Sundance fire (1967), was used for certain extrapolations. Reconstructed fire behavior and estimated smoke production suggest that current nuclear winter models overestimate the magnitude of a wildland component.

4258 **(AD-A—995498/3/XAB) Operation Redwing. OPS Plan 1-56. Volume 2.** (Joint Task Force Seven, Washington, DC (USA)). 19 Feb 1987. 376p. NTISMF A01.

Extracted version of report dated 15 February 1956; Availability: Microfiche copies only.

4259 **(BARC—1340) Identification of depth phase onsets from some presumed underground explosion signals using prediction error filtering.** Roy, F. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700303/JAW.

This report presents the applicability study of the prediction error filtering for the identification of depth phases corresponding to some presumed underground explosions in USSR region. For six events from eastern Kazakh, USSR (EKZ) region, the data of Warramunga array (WRA) and Gauribidanur array (GBA) have been analysed. The source depths as estimated from GBA and WRA data were in good agreement. Apart from these six events, a set of 23 events from various test sites in USSR as recorded in GBA were subjected to prediction error filtering and in each case the depth phase was identified. A time separation as small as 0.3s between P and the p/sup p/ phase could be resolved successfully. Several weak presumed explosion signals from USSR region were also analysed and a comparative study was done for these weak events using prediction error filtering with and without pre-filtering the noise. It was demonstrated that the pre-filtering of noise improved the depth phase identification capability substantially in case of weak signals. 39 figures, 9 refs.

4260 **(BARC—1341) Detection of depth phase onsets by prediction error filtering of synthetic signals in presence of additive noise after prefiltering the noise.** Roy, F. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700304/JAW.

Prediction error filtering has been found very useful for the identification of the depth phases corresponding to weak and shallow events. Its applicability can be further improved provided the ambient seismic noise is reduced by some means. A parametric model based on autoregressive (AR) method has been shown to be suitable for this purpose. In this method, the noise preceding the signal is modelled as an AR process. The time series comprising pre-event noise and the composite waveform consisting of P and the P/sup P/ phases is filtered using the above AR model. Due to this filtering, the original time series is changed into a new time series. Though the P signal structure changes, the structure of the reflected or the depth phase also changes the same way. The spectrum of the new modified signal will be close to S(w)/N(w), where S(w) is the P wave spectrum and N(w) is the spectrum corresponding to the preceding noise in the original time series. The modified signal will have predominant amplitudes around the frequencies w, for which S(w) happens to be large compared to N(w). However, the new time series will be contaminated with a band limited white noise series. By appropriate digital filtering of the new time series and after remodelling the filtered time series using AR method, it has been shown that the onsets of the depth phases from very weak signals can be successfully extracted. A signal having signal to noise ratio (SNR) of 2 or more can be successfully subjected to this method for locating the onsets of the depth phases. For even weaker signals (SNR $\simeq$ 1), one can subject the array beams to this method for the extraction of the depth phases. 10 refs., 3 tables, 22 figures.

4261 **(CONF-871101—57) Extinction cascade: Biological consequence of nuclear war/winter.** Vaughan, G.L.; Pimm, S.; Fields, D.E. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014400/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

In very general terms, this report describes the effects on biological organisms of a nuclear war and the projected nuclear winter that would follow. (TEM)

4262 **(CONF-8710117—4) Maximum entropy tomography in weapons diagnostics.** Johnson, D.E. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA)). Oct 1987. Contract AC08-83NV10282. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000998/JAW.

From DNA conference on instrumentation for nuclear weapon effects testing; Arlington, VA, USA (6 Oct 1987).

Tomographic reconstruction is a mathematical technique that has existed as a theory since the early part of this century. It was obvious that a two-dimensional image could be integrated in one direction to produce a one-dimensional curve. This curve is called a projection. The question was whether these projections could be recombined to reproduce the original image. It was shown that with continuous projections at all possible angles, the image could indeed be reproduced. The result was interesting, though not very useful. With the advent of computers large enough to handle the computation, the question became whether tomographic reconstruction could be reasonably approximated digitally, with a finite number of points representing the projections at a finite number of angles. The medical community has demonstrated that the approximation is acceptable; their reconstructions are often done with pro-

jections of 512 points at angles in increments of half a degree, from 0 to 180°. Maximum entropy tomography allows us to do a reconstruction when only a limited number of data points are available. This technique will converge to a unique solution; it also will cope with noisy data to some degree. Maximum entropy tomography is derived by using Legrange multipliers to combine the equations relating the projections to the image with the equation defining entropy for the image. The resultant combined equation is maximized with respect to the image. The solution is in a form that can be iterated to produce a unique image from a specific set of projections. This technique has been adapted to downhole weapons diagnostics. Two different neutron imaging experiments, TITIS and TOMEX, use maximum entropy tomography. In both cases the amount of data that can be collected is limited by how much equipment can be placed downhole and by the amount of time available to collect the data.

4263 **(GAO/NSIAD—87-15) Nuclear weapons: Emergency preparedness planning for accidents can be better coordinated.** (General Accounting Office, Washington, DC (USA)). 1987. 72p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Nuclear weapons will be carried on some of the ships the Navy plans to add to existing and new U.S. homeports. Coordination and planning with states and localities for public safety in the event of a nuclear weapon accident varies by service. The Navy and Army generally have not coordinated this planning as they have for other types of disasters because they believe to do so would compromise national security. The Air Force coordinates its emergency planning for all types of disasters. DOD believes that while it is possible for Navy homeports to coordinate preparedness plans on an unclassified basis it is not possible to do so at nuclear weapons storage sites because of security constraints.

4264 **(SAND—87-2623C) New approach to telemetry development will significantly increase productivity of Joint Test Assembly (JTA) teams.** Gee, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 27 Oct 1987. Contract AC04-76DP00789. 10p. (CONF-8710171—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001676/JAW.

From International telemetering conference; San Diego, CA, USA (27 Oct 1987).

We design telemetry systems which instrument weapons in the Joint DoD/DOE flight test program. These telemetry systems gather data which can be used to determine if a weapon system functioned as intended. A reusable telemetry electronics system to support new programs for the next decade and to replace old telemetry systems which can no longer be produced is being designed. This multisystem Joint Test Assembly, named JTAX, is being designed to be modular, flexible, and testable. The requirements for each program can be met by choosing the necessary circuitry from a list of "off-the-shelf", flexible electronics modules. Present day electronics miniaturization will allow these modules to consist of a few integrated circuits. System-specific circuits can be added to the architecture via well-defined interfaces. Off-the-shelf and system-specific circuitry are connected on printed circuit boards which are designed to meet the unique mechanical constraints for each system. 3 figs.

4265 **(USGS/WRIR—86-4342) Hydrogeology of the Faultless site, Nye County, Nevada.** Thordarson, W. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 45p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001305/JAW.

The Faultless event was the detonation of an intermediate-yield nuclear device on January 19, 1968, at a depth of 975 m below the surface of Hot Creek Valley, Nevada. This report presents details of the hydrogeology of the rubble chimney and radiochemical monitoring in re-entry hole UC-1-P-2SR. The surface location of re-entry hole UC-1-P-2SR is about 91 m north of the emplacement hole, UC-1. Re-entry hole UC-1-P-2SR was drilled to a total depth of about 1097 m. The hole penetrated Quaternary and Tertiary valley-fill sediments above the rubble chimney, as well as Quaternary and Tertiary valley-fill and Tertiary tuffaceous sediments within the chimney and rubble-filled cavity. Monitoring of the water level in re-entry hole UC-1-P-2SR indicated that, from 1970 to 1974, the water level was 695 m below land surface. During filling of the rubble chimney from 1974 to 1983, the water level rose slowly to a depth of 335.1 m. The 1983 level was about 167 m below the pre-event level that was about 168 m below land surface. Water with temperatures ranging from 37 to 61°C occurred at the bottom of the re-entry hole at depths ranging from 728 to 801 m. A temperature of 100°C at a depth of 820 m was projected from temperature logs. The hydraulic connection between the re-entry hole and the rubble chimney is considered poor to fair. Chemical analyses of water samples indicate that the water predominantly was a sodium bicarbonate type. Chemical and radiochemical analyses indicated that, although the constituents generally increased with increasing depth, three distinct water-quality zones have lasted for more than 16 years, even during the rising water level. The hot, radioactive water from the Faultless event apparently rose into the lower zone concomitant with the rising water level, as the rubble chimney was being filled. This general rise was interrupted by the apparently major dilution from colder water descending from the upper zone during 1975 and 1977.

4266 **Debate on APS directed-energy weapons study.** Canavan, G.H.; Bloembergen, N.; Patel, C.K.N. (Physics Division at Los Alamos National Laboratory). *Physics Today;* **40**: No. 11, 48-53(Nov 1987).

Is it unduly pessimistic to conclude that it would take a decade or more of intensive research just to determine the feasibility of shielding the US with a system of high-intensity laser and energetic particle beam weapons?

4503 Explosion Detection

4267 **(AD-A—183827/5/XAB) Preliminary analysis of seismic variability at the Shagan River nuclear test site. Final report.** Dermengian, J.M.; Murphy, J.R.; Barker, B.W. (S-Cubed, San Diego, CA (USA)). Dec 1985. 75p. (SSS-R—87-7580). NTIS, PC A04/MF A01.

Large volumes of teleseismic P-wave amplitude and arrival-time data recorded from explosions at this test site were collected and statistically analyzed in an attempt to define any systematic trends which correlate with source location. The results of the analysis of the teleseismic m/sub b/ data were shown to provide strong evidence of systematic geophysical variations within the Shagan River testing area. In particular, the m/sub b/ station corrections were shown to vary with source location in a manner that depends on source-to-station azimuth. Results of detailed comparisons of m/sub b/ residual data at common stations from selected pairs of nearby explosions were used to conclude that the observed variations in the azimuthal patterns of the m/sub b/ residuals are related to event location rather than tectonic release effects. Results of this preliminary analysis suggest that the observed m/sub b/ differences may be associated with changes in the near-source portions of the teleseismic P-wave propagation paths. In contrast to the m/sub b/ residual data, the reduced P-wave travel-time residuals were found to show no obvious correlation with event location, and this has been interpreted as an indication that the available bulletin data are not precise enough to resolve the rather small travel-time variations which might be expected to accompany the observed m/sub b/ variations.

4268 **(AD-A—183828/3/XAB) Analysis of the effects of tectonic release on short-period P waves observed from Shagan River explosions. Final report, September 1985-September 1986.** Barker, B.W.; Murphy, J.R. (S-Cubed, San Diego, CA (USA)). Feb 1987. 65p. (SSS-R—87-8422). NTIS, PC A04/MF A01.

Large samples of teleseismic P-wave amplitude and waveform data recorded from Shagan River underground explosions were collected and systematically analyzed in an attempt to identify any effects which may correlate with the amount of tectonic release accompanying these explosions. Results of these analyses indicate that these teleseismic P-wave data do not provide any unambiguous evidence of effects of tectonic release in the short-period range of interest in m/sub b/ determination. However, the results of a preliminary theoretical analysis indicate that such negative evi-

dence is not definitive in that there are plausible models of tectonic release for which no detectable variations in the observed teleseismic P waveforms are theoretically expected to result from the superposition of these two sources. At the same time, such models of tectonic release predict significant positive bias in the network-averaged m/sub b/ values for explosions accompanied by the mode of tectonic release traditionally associated with the Shagan River test site. Thus, the currently available seismic data do not exclude the possibility that tectonic release may be introducing a positive bias of as much as several tenths of a magnitude unit into the network-averaged m/sub b/ values computed for some Shagan River explositons.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

4269 **(TVA/ONRED/EQS—87/1) Tennessee Valley Authority environmental research summary, 1987.** Brown, L.R.; Green, R.E. (eds.). (Tennessee Valley Authority, Knoxville (USA). Environmental Quality Staff). 1987. 63p. NTIS, PC A04/MF A01. Order Number DE88900014/JAW.

This annual report summarizes environmental research activities of the Tennessee Valley Authority, conducted during fiscal year 1986. This research is conducted to identify and resolve environmental problems associated with TVA's programs. TVA also considers the search for effective, practical means of protecting and enhancing the environment to be a vital component of its mission to develop and conserve the natural resources of the Tennessee Valley region. Most of TVA's environmental research activities are directed toward developing practical solutions within six broad categories of problems and issues related to the protection and enhancement of regional environmental quality. These six categories are: (1) Acid Deposition; (2) Air quality; (3) Groundwater; (4) Hazardous Materials and Waste Management; (5) Surface Water Quality and Reservoir Ecology; and (6) Forest and Wildlife Management. An appendix is included to provide the name and address of the project director responsible for each project described in the six sections.

5001 Basic Studies

REFER ALSO TO CITATION(S) 2896, 3986

4270 **(ANL/ER-TM—87-1, pp G.1-G.3) Dynamics of complex thunderstorm outflows.** Achtemeier, G.L. (Illinois State Water Survey, Champaign). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this study are to further the understanding of the dynamics of complex thunderstorm outflows by the investigating: 1) outflow interactions among clusters of storms, 2) outflows produced by clusters of storms that have merged to form a common front, and 3) outflows that propagate great distances from the parent storm systems. The studies focus on outflows from storms within humid climates where both moist and dry outflows exist within simple and complex thunderstorm systems. In this study, the mechanisms responsible for the formation, movement, strength, and persistence of thunderstorm outflows are investigated with particular reference to: 1) the relative importance of downward transport of horizontal momentum from aloft and the hydrostatic pressure forces within the cold dome beneath the downdraft in accelerating the air horizontally at the surface into gust flows, 2) how nonhydrostatic pressure forces near the head of the gust front modify its propagation speed, 3) and the role of coriolis acceleration in the maintenance of gust front structure and longevity.

4271 **(GSF—4/87) Atmospheric dispersion calculations in a low mountain area.** Schmid, S. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Jan 1987. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750027/JAW.

The applicability of the Gaussian model for assessing the short-range environmental exposure from an emission source in a topographically inhomogeneous terrain is tested. An atmospheric dispersion model of general applicability is used, which is based on results of hydrodynamic flow models. Approaches for turbulence and radiation parameterization are tested by means of a vertically one-dimensional flow model. In order to introduce the effects of the topography in the boundary-layer simulations, the three-dimensional mesoscale model (Ulrich) is applied. The two models are verified by way of episode simulation using wind profile measurements. The differences in the models' results are to show the topographic influence. The calculated flow fields serve as input to a randomwalk model applied for calculating ground-level concentration fields in the vicinity of an emission source. The Gaussian model underestimates the pollution under stable conditions. Convectivity conditions may change the effective source hight through vertical effects caused by orography which, depending on the direction of free flow, leads to an increase or decrease of pollutant concentration at ground level. Applying the more complex dispersion model, the concentration maxima under stable conditions are closer to the source by a factor five, and under unstable conditions about one and a half times more remote.

4272 **(PB—87-223806/XAB) CSIRO (Commonwealth Scientific and Industrial Research Organization) Division of Atmospheric Research, research report 83-85.** (Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research). 1986. 101p. NTIS, PC E06/MF E06.

The report is a description of the first two years of activity of the new Division of Atmospheric Research. The Division's rationale for the main research program structure is based on a fourfold approach to atmospheric research, involving: The material structure of the atmospheric system (atmospheric constituents); The primary forcing mechanism (solar and terrestrial radiation, together with clouds which are a principal interactive control on the radiation budget); The dynamical response of the system on a regional scale (small-scale dynamics); and the dynamical response of the system on a planetary scale (large-scale dynamics).

4273 **(PB—87-228391/XAB) National Center for Atmospheric Research annual report for Fiscal Year 1986.** (National Center for Atmospheric Research, Boulder, CO (USA)). Jun 1987. 86p. (NCAR/AR—86). NTIS, PC A05/MF A01.

See also report for FY 84, PB—85-191237; Color illustrations reproduced in black and white.

Report describes ongoing research activities and the most significant recent achievements of the National Center for Atmospheric Research, which is operated by the 54-member organization, the University Corporation for Atmospheric Research, under the sponsorship of the National Science Foundation. A section of directories lists the scientific and technical staff, organizational structure, financial statements, visitors and publications. Abundant illustrations and photographs, and a semitechnical narrative makes the report accessible to a wide readership of science administrators, decision makers, students, and interested laypeople.

4274 **(UCRL—97354) Interpretation of our present terrestrial climatic record.** Ellsaesser, H.W. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 14p. (CONF-8708146—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000223/JAW.

From Workshop on monitoring climate; Fort Collins, CO, USA (26 Aug 1987).

Detailed studies of profiles of $\delta^{18}O$ in oceanic and glacial cores and of pollen deposits in bogs indicate that the terrestrial climatic system, consisting of the atmosphere, hydrosphere, lithosphere and biosphere, is capable of oscillations with amplitudes, such as that of the Melisey II stadial of northern France, approaching or equaling that of the glacial-interglacial cycle but on time scales too short for the usually envisioned transfer of mass between the oceans and continental glaciers. Abrupt oscillations or shifts to new equilibrium are well documented in the Boelling-Aleroed warming and Younger Dryas readvance, the 0.4°C rise in NH continental air temperature circa 1920 and the year-to-year oscillations in NH con-

tinental air temperatures from 1976 to 1984. Such abrupt oscillations defy explanation in terms of external forcing functions and suggest rather internal rearrangements within the climate system as the driving mechanism. Suggestions are made as to mechanisms for possible internal rearrangements which might lead to different hemispheric or global mean surface temperatures.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2803, 2817, 2856, 2857, 2859, 2910, 3183, 3184, 3185, 3186, 3187, 3188, 3189, 3190, 3191, 3193, 3194, 3195, 3196, 3352, 3355, 3557, 3614, 3631, 3633, 3656, 3924, 4257, 4271, 4274, 4342, 4500, 4544, 4549, 4551

4275 **(AD-A—183014/0/XAB) Laser remote sensing of atmospheric pollutants. Final report, 1 October 1984-30 September 1985.** Killinger, D.K.; Menyuk, N.; Mooradian, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Sep 1985. 65p. NTIS, PC A04/MF A01.

This FY85 Final Report on the program entitled Laser Remote Sensing of Atmospheric Pollutants covers the period 1 October 1984 to 30 September 1985. The work was supported by the Air Force Engineering and Services Center. The specific tasks conducted for this research program consisted of the following: (a) continuation of the Co:MgF2 DIAL measurement of atmospheric species, and (b) initial remote-sensing demonstration of a HC1 plume in the atmosphere. Each of these tasks is described in detail. Supportive documentation is included in the appendices.

4276 **(AD-A—183468/8/XAB) Inorganic bromine in the lower stratosphere.** Gallagher, C.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1987. 5p. (AFGL-TR—87-0222). NTIS, PC A02/MF A01.

Pub. in Jnl. of Atmospheric and Terrestrial Physics, Vol. 49, No. 3, 299-302(1987).

Inorganic bromine content in the lower stratosphere was determined from a series of three balloon flights conducted in 1981 and 1982 from Holloman AFB, New Mexico (33 N). A direct-flow sampler (DFS) sampled large quantities of stratospheric air through a 35-cm-diameter filter mounted upstream of a blower. Filters were prepared with an inert organic oil and a strong organic base in order to capture both acidic and particulate species. Following flight, the filters underwent an extraction process. Then, aliquots of the solution were subjected to neutron-activation analysis. The methodology involved a radiochemical procedure which was developed and tested to measure, simultaneously, both chlorine and bromine content. High-resolution gamma spectrometry was used and bromine content was determined by counting Br activity. The resulting values of volume mixing ratios of bromine increased from a low of 2.6 parts per total volume 15 km to a high 15.6 parts per total volume for the 25-30 km band. The results are shown to be in agreement with earlier measurements by SEDLACEK et al. (1984) and with one-dimensional photochemical model predictions by YUNG et al. (1980).

4277 **(AD-A—183735/0/XAB) Volatile organic carbon emissions. Phase 2. Final report, April 1985-December 1986.** Jake, C.A. (Hercules, Inc., Radford, VA (USA)). Feb 1987. 166p. NTIS, PC A08/MF A01.

Availability: Documemt partially available.

Engineering studies evaluated bisulfite (HSO_3) absorbent solutions in a bench-scale absorption unit for the control of volatile organic compounds (VOCs) emitted from the manufacture of multi-base propellent at Radford Army Ammunition Plant. An optimization study showed that a dual-column absorption system is required for the removal of solvent vapors: a recycle column containing 15 wt% (HSO_3) absorbent solution and a single-pass column using plant-process water. The recycle column concentrated acetone to 1.6 wt% in the absorber bottoms, resulting in 40-85% solvent recovery by distillation; the single-pass column failed to concentrate ethanol sufficiently for recovery. The 15 wt % HSO_3 absorbent solution also destroyed both neat and vaporous nitroglycerin. Economic analyses of the proposed process designs for the multi-base propellant mixing process and forced air drying operations indicated HSO_3 absorbent systems to be uneconomical. Therefore, alternative VOC abatement systems were cursorily evaluated, including glycols and sulfuric acid as absorbents, membrane technology, Ceilcote's VOC control system, and Union Carbide's PURASIV HR solvent recovery process.

4278 **(DOE/ER—0347) Carbon dioxide and climate: Summaries of research in FY 1987.** (USDOE Office of Energy Research, Washington, DC. Carbon Dioxide Research Div.). Oct 1987. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000916/JAW.

This report describes the activities and products of the Carbon Dioxide Research (CDR) Program in fiscal year 1987. Project descriptions are categorized according to program areas: energy systems, climate systems, agro-ecosystems, resource analysis, scientific interface, and integration and evaluation. (ACR)

4279 **(EIR—616) Atmospheric-physical measuring system of the project 'Air pollution' (forest decline) at the Laegeren Mountain.** Nater, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jun 1987. 115p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750009/JAW.

After a short introduction on the problem of 'forest decline' in general and a presentation of the research program there follows a description of the individual measurement systems. The field experiment is concentrated on the Laegeren area in the Swiss Middle Land, where four towers up to 70 m have been constructed and equiped with sensors for measuring meteorological and air-chemistry parameters. One main point of this particular project is the research on acid fog which is believed to be one of the main suppliers of pollution particles and gases.

4280 **(GAO/RCED—86-91) Air pollution: Sulfur dioxide emissions from nonferrous smelters have been reduced.** (General Accounting Office, Washington, DC (USA)). 1986. 40p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency and the states have been effective in getting smelters to take the steps necessary to comply with the Clean Air Act requirements for reducing sulfur dioxide emissions and violations of national ambient air quality standards. The 1984 levels for both sulfur dioxide emissions and violations of standards for sulfur dioxide have been reduced by at least 75 percent of the levels experienced in the early or mid-1970s. An issue remains concerning EPA and sate review of applications for second-period nonferrous smelter orders. Three smelters have requested a second-period order. Two of those smelters, both located in Arizona, were unable to prevent violations of the standards, as required by the act, while operating under their first-period order. To qualify for a second-period order, EPA and Arizona have requested that these two smelters improve their intermittent control systems to ensure that future violations do not occur.

4281 **(GAO/RCED—86-117BR) Chemical emergencies: Preparedness for and response to accidental air releases.** (General Accounting Office, Washington, DC (USA)). 1986. 62p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

This report provides information on the efforts of the federal government, state, and local governments in three states-Louisiana, Michigan, and New Jersey-and the chemical industry to prepare for and respond to chemical plant emergencies. The role of the federal government is primarily to ensure that local government personnel are prepared to respond to chemical plant accidents. Many of the federal initiatives have only recently been implemented and its is too early to evaluate their impact on improving local community preparedness and response capabilities. Although there is no federal legislation requiring emergency preparedness for communities with chemical plants, proposals to reauthorize Superfund contain provisions which would require local governments to prepare response plans and the governors of the states to review them.

4282 **(GAO/RCED—87-76) Air pollution: States assigned a major role in EPA's air toxics strategy.** (General Accounting Office, Washington, DC (USA)). 1987. 40p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency initiated a strategy whereby states would set standards and regulations for toxic air pollutants and pollution sources that ERA found to pose no national problems. The strategy of broad delegation to the states raised three areas of concern consisting of legal issues, public health implications due to inconsistencies in state programs, and industry location implications. This delegation of regulatory responsibility is now under litigation.

4283 **(GSF-BPT—8/86) IMA-seminar 'deposition'.** Hoefken, K.D.; Bauer, H. (eds.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). 1986. 101p. (In German). (CONF-8602150—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW.

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

All papers of this symposium are dealing with deposition including the description of different measuring methods and its consequences for ecosystems. Separate abstracts were prepared for 9 papers of this report.

4284 (IAEA-TECDOC—428, pp 21-30) **Energy transfer induced oxidation processes in flue gases.** Busi, F.; D'Angelantonio, M.; Mulazzani, Q.G.; Tubertini, O. (Consiglio Nazionale delle Ricerche, Bologna, Italy. Lab. di Fotochimica e Radiazioni d'Alta Energia; Bologna Univ., Italy. Istituto Chimico G. Ciamician). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

Irradiation of flue gases with electrons has been proposed as the most effective method for the simultaneous removal of NO/sub x/ and SO/sub 2/. Oxidizing radicals OH, HO/sub 2/, and O, are produced in the energy transfer process from incident radiation to the molecules of the system. The reactions of NO/sub x/ and SO/sub 2/ with the oxidizing radicals yield nitric, sulfuric, nitrosylsulfuric, and nitrylsulfuric acids. When irradiation occurs in the presence of ammonia the neutralization products may be removed from the flue gas by a dry electrostatic precipitator. We have developed a generalized model for radiation induced oxidation of exhaust gases; the results of the mathematical simulations are in good agreement with reported experimental data. 19 refs, 12 figs.

4285 (IAEA-TECDOC—428, pp 55-84) **Flue gas simultaneous DeNO/sub x//DeSO/sub x/ by impulse corona energization.** Civitano, L.; Dinelli, G.; Busi, F.; D'Angelantonio, M.; Gallimberti, I.; Rea, M. (Ente Nazionale per l'Energia Elettrica, Pisa, Italy. New Techniques Dept., CRTN; Consiglio Nazionale delle Ricerche, Bologna, Italy. Lab. di Fotochimica e Radiazioni d'Alta Energia; Padua Univ., Italy. Ist. di Elettrotecnica e di Elettronica). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

A new electrochemical technique for the combined abatement of NO/sub x/ and SO/sub 2/ based on irradiation with high energy electrons of the flue gas seems to represent an interesting alternative to conventional chemical processes which have the advantage of being already industrially developed but at the same time the drawback of being rather expensive. With such a technique oxidizing radicals as OH, HO/sub 2/ and O are produced and the reactions of NO/sub x/ and SO/sub 2/ with the radicals yield several acids that can be neutralized by injecting either ammonia or lime into the gas; the final products, being solid particles, can be removed from the flue gas in an electrostatic precipitator. As the theory suggests that the photochemical reactions taking place in the flue gas occur with electrons of lower energy, the use of an impulse corona discharge as a suitable or even more convenient source of ionizing electrons has been tested with a simple test rig using real flue gas. The theoretical and experimental results seem to be quite consistent and are encouraging enough to suggest that the research activity should be carried further with a view to characterizing the process more accurately, since the role played by several of the process parameters is still not known, and to developing impulse voltage generators suitable for industrial applications. 23 refs, 22 figs, 7 tabs.

4286 (IAEA-TECDOC—428, pp 85-94) **Energetic aspects of radiation-induced SO/sub 2/ removal in electric fields.** Boes, J. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

The applicability of electron beam processing of flue gases strongly depends on the radiation chemical yield of the pollutant removal. The present paper is dedicated to the attempt to increase the G-value of the radiation-induced SO/sub 2/ conversion by electrostatic fields. Applying electric fields to the reaction vessel located in an irradiation plant a growth of the yield of SO/sub 2/ oxidation in two regions of the electric field strength, between 10 and 100 V.cm/sup -1/ and between 10/sup 3/ and 3 x 10/sup 4/ V.cm/sup -1/ for model gas mixtures was observed. At low field strengths G-values up to 100-120 and at high field strengths yields up to 20-30 have been measured. Another advantage of the radiation-field combination is the possibility of substitution of radiation energy by the cheaper energy of the electric field. 14 refs, 6 figs.

4287 (IAEA-TECDOC—428, pp 211-218) **Considerations of source scaling for the stack gas application.** Williams, K.E.; Nablo, S.V.; Fletcher, P.M. (Energy Sciences Inc., Woburn, MA, USA). Jul 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700363/JAW. (CONF-8610346—).

From Consultants' meeting on electron beam processing of combustion flue gases; Karlsruhe, F.R. Germany (27 Oct 1986).

High energy (approximately 800 kV), low power (approximately 150 kW), scanned source electron beam accelerators have been used effectively by Ebara and others in establishing the scientific proof-of-principle of the pollution abatement possible using electron beam processing of stack gases. The simultaneous removal of greater than 90% SO/sub 2/ and NO/sub x/ has been demonstrated. Recently, low energy (approximately 300 kV), low power (approximately 180 kW) line source electron beam accelerators also have demonstrated the removal of these pollutants. What is needed now in order to economically address the full-scale pollution abatement requirements of electric power plants generating 300-1500 MW are high power accelerators capable of operating at electron beam power levels approaching 1 MW. In this paper some of the critical scaling issues required to accomplish this are considered and it is concluded that the two-accelerator, line source module is the system of choice for large scale stack gas applications requiring efficient deposition of electron beam energy in the gas. 5 figs.

4288 (INIS-mf—10730, pp 89-103) **Aerophysical studies on dissemination and deposition exemplified by nutrient aerosols.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

Dissemination can be described by the Gauss model though deviations by a factor of 2 have to tolerated in individual measurements. The deposition of aerosols exhibiting an air-moisture-dependent mean aerodynamic diameter between 0.9 μm to 1.7 μm, had an average speed of ca. 0.6 cm/sec/sup -1/ in the spruce stand examined. The studies performed at Echte in the Harz foothills were extended to source distances of up to 200 m.

4289 **(KFK—PEF-23) Field experiment for the assessment of the transport of air pollutants in the State of Baden-Wuerttemberg. Experimental contributions.** Huebschmann, W.; Thomas, P.; Vogt, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Meteorologisches Inst.). Apr 1987. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750012/JAW.

The TULLA measuring campaign served to assess the transport and transformation of airborne pollutants in Baden-Wuerttemberg and from neighbouring states. During four intense measuring phases, each of 24 or 36 hours duration, the windfield and the concentration distribution of the main air pollutants, mainly SO/sub 2/, has been assessed. Additionally to measuring the windfield by radiosondes and tethered balloons, 12 tetroons have been launched and tracked by radar up to distances of 111 kms. From the trajectories the horizontal dispersion parameter σ/sub y/ has been derived and the turbulence intensities were evaluated. Three mesoscale diffusion experiments have been performed, using SF/sub 6/ as a tracer. Air samples have been taken up to 60 km distances from the source. The σ/sub y/ derived from these experiments and from tetroon trajectories compare well when based on the same sampling time. With 12 refs, 47 figs., 26 tabs.

4290 **(NP—8750144) International comparison of NO/sub x/ emissions.** Slama, J. (Osteuropa-Inst., Muenchen (Germany, F.R.)). Sep 1986. 21p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750144/JAW.

NO/sub x/ emission data from 8 Eastern European countries and 18 Western European countries were compared. A considerable difference was found and analyzed statistically. Per capita emissions are 50% higher in Eastern Europe than in Western Europe; per unit emissions are more than twice as high. The difference is interpreted in terms of an immensely higher energy consumption.

4291 **(PB—87-212726/XAB) Feasibility of field studies of multipollutant interactions.** Lippmann, M. (New York Univ., NY (USA). Inst. of Environmental Medicine). Jul 1987. 18p. (EPA—600/D-87/231). NTIS, PC A02/MF A01.

The author provides an overview of the problems and progress to date in studies of the respiratory health effects of multiple air pollutants. The problem arises because the preference for single (or even multiple) pollutants in lab studies does not replicate the conditions of actual exposure to complex pollutant mixtures for the general population. The limits of interpretation possible in more realistic studies is stressed. The examples of SO_2-particulate matter and lead-nutritional factors are presented as two cases where laboratory-generated data lagged behind epidemiologic studies in their ability to corroborate multiple exposure-disease associations identified in field studies of humans. An extensive review of laboratory and field studies of multipollutant interactions is provided. The paper ends with a call for more field studies with enhanced measurements of exposures, and outcomes.

4292 **(PB—87-214052/XAB) Comparison of optical and electron microscopy for evaluating airborne asbestos.** Cherrie, J.W.; Dodgson, J.; Groat, S.; Carson, M. (Institute of Occupational Medicine, Edinburgh (UK)). Feb 1987. 56p. (TM—87/01). NTIS, PC E06/MF E06.

In order to assess the very low asbestos exposures found outside the workplace it is necessary to make fibre counts by electron microscopy. Results from scanning electron microscope (SEM) and transmission electron microscope (TEM) and phase-contrast optical microscope (PCOM) methods are compared. Different types of laboratory prepared asbestos samples and actual industrial and nonoccupational samples were used. The report concludes that to convert asbestos fiber concentrations determined by EM to PCOM equivalent concentrations the EM fiber concentration should be divided by 4.0 for chrysotile and 1.7 for amphibole asbestos. It is recognized that different factors may be required for the various amphibole types, however, the data from the present study are insufficient to make these distinctions.

4293 **(PB—87-214060/XAB) Preliminary investigation of aerosol exposure associated with operation of a hand-held electrodynamic crop sprayer. Final report, July-December 1986.** Johnston, A.M.; Hughson, G.W.; Vincent, J.H.; Jones, A.D. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1987. 55p. (TM—87/06). NTIS, PC E06/MF E06.

The aim of the investigation was to relate the amount of pesticide material inhaled by an operator to that delivered from his hand-held electrodynamic crop spraying device. The operator was a full-size tailor's mannequin fitted with a nasal-filtration unit connected to a breathing machine. Determination of the amount of material inspired during a given spraying period was by fluorimetric analysis of the amount of the Uvitex-B tracer dye contained in the formulation collected on the nasal filter. Both calm- and moving-air situations were investigated, the latter in a large wind tunnel. Assessment of the correlation between the results obtained for several different types of personal sampling devices and the inspired volume was also undertaken.

4294 **(PB—87-218251/XAB) Health effects of exposure to wood dust: a summary of the literature.** Tatken, R.L.; Browning, C.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 164p. NTIS, PC A08/MF A01.

The report identifies and summarizes the literature on the potential health effects of exposure to wood dust. The comprehensive literature review defines wood, discusses occupational-exposure standards and recommendations for wood dust, describes reports of animal and in vitro testing, and examines human health effects including dermatitis, allergic respiratory effects, mucosal and nonallergic respiratory effects, and carcinogenicity. Also included is a compilation of wood-dust concentration ranges reported for various wood-working operations and a brief discussion of wood-dust control technology. The report does not contain NIOSH recommendations for regulating occupational exposure to wood dust.

4295 **(PB—87-221198/XAB) Field comparison of measurement methods for nitric acid. Final report.** Hering, S.V. (California Univ., Los Angeles (USA). Dept. of Chemical Engineering). 20 Apr 1987. 71p. NTIS, PC A04/MF A01.

Eighteen instruments for measuring atmospheric concentrations of nitric acid were compared in an eight day study at Pomona College, situated in the eastern portion of the Los Angeles Basin, September 1985. The study design included collocated and separated duplicate samplers, and the analysis by each laboratory of a set of quality-assurance filters, so that the experimental variability could be distinguished from differences due to measurements methods. For all sampling periods, the values for nitric acid concentrations reported by the different instruments vary by as much as a factor of four. Overall, the highest reported concentrations are from the filter packs, lower concentrations are given by the transition-flow reactors, annular denuders and tunable-diode-laser absorption spectrometers. When the nitric acid concentrations were high enough to be detected by the Fourier-transform infrared spectrometer (FTIR), the FTIR values were closest to those obtained by the denuder difference method (DDM) and the mean value from the other sampler methods.

4296 **(PB—87-222154/XAB) Health-hazard evaluation report HETA 84-401-1784, Nutech Corporation, Denver, Colorado.** Pryor, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 13p. (HETA—84-401-1784). NTIS, PC A02/MF A01.

In response to a request from management at the NuTech Chemical Corporation located in Denver, Colorado, an evaluation was made of possible employee exposure to copper sulfate, sulfuric acid, and acetic acid at the facility. The company has recently begun producing odorizing chemicals for sulfuric acid waste treatment, food and by-products operations, set odors, and other uses. Personal breathing-zone and area samples for acetic acid ranged from 12.6 to 51.3 mg/cu m, indicating that some exceeded the OSHA Standard of 25 mg/cu m. Before the employees began using personal protective clothing, they had experienced irritation to the eyes, nose and throat. Sulfuric acid and copper sulfate were not detected. The author recommends that a local exhaust ventilation

system be installed in the chemical mixing location. An eyewash station and safety shower should be made immediately accessible to workers. Preplacement and periodic medical examinations should be instituted giving particular attention to skin, eyes, teeth, and respiratory-tract problems and including pulmonary function tests.

4297 (PB—87-222360/XAB) Industrial-hygiene survey report, Parkway Products, Inc., Cincinnati, Ohio. Clapp, D.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 44p. (IWS—144.13). NTIS, PC A03/MF A01.

Industrial hygiene and biomonitoring data were collected during a survey at the Parkway Products Inc. facility located in Cincinnati, Ohio, one of the largest users of 4,4'-methylenebis (2-chloroaniline) (MBOCA). Customized polyurethane products were manufactured for industry at this facility. Urinary concentrations of MBOCA were below the California standard of 100 micrograms/liter, with the exception of two samples taken from MBOCA mixers. The wipe samples taken showed a range of concentrations from 4 to 53 micrograms MBOCA per wipe which were collected near the MBOCA room where the chemical was stored as well as handled. Night-shift workers were exposed to higher concentrations, probably indicating that less care was taken during this shift in controlling the hazardous substance. There was no clear cut relationship established between environmental and biomonitoring results in this study, except for the workers in the MBOCA room. The author recommends frequent washing down of exposed areas, changing protective workclothes in specified facility locations, prohibition of eating or drinking or smoking in work areas, monthly urine monitoring, and continued education as to the hazards of the job.

4298 (PB—87-222444/XAB) Industry-wide studies report of an in-depth survey at the Goodyear Tire and Rubber Company, Houston Chemical Plant, Houston, Texas. Krishnan, E.R.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 16 Apr 1987. 49p. (IWS—147.34B). NTIS, PC A03/MF A01.

In order to assess worker exposure to 1,3-butadiene, an industrial-hygiene survey was conducted at the Goodyear Tire and Rubber Company located in Houston, Texas. A total of 117 personal samples were collected over three shifts representing all job categories with potential exposure. A total of 14 area samples were also collected. Arithmetic and geometric mean full shift exposures across all job categories were less than 15.0 parts per million (ppm). The highest arithmetic mean full-shift exposures of 15.0 ppm were for laboratory technician and pipefitter categories. The highest individual level monitored was 43.2 ppm for a pipefitter. The airborne area samples were at or below about 1.0 ppm. Concentrations of 1,3-butadiene at the facility perimeter were less than 0.20 ppm. The authors recommend that Goodyear consider conversion to a closed-loop sampling system for obtaining quality-control samples. This would lower the mean and peak exposures of instrument lab chemists. Leaking pumps, though not observed during these visits, can be hazardous; dual mechanical seals should be used. The general dilution ventilation conditions and hood face velocities in the quality-control labs should be investigated. Employees assigned to the task of pipefitting should use respirators with organic-vapor cartridges.

4299 (PB—87-222493/XAB) Health-hazard evaluation report HETA 82-147-1783, Converters Ink Company, Linden, New Jersey. Gann, P.; Liveright, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 21p. (HETA—82-147-1783). NTIS, PC A02/MF A01.

The management of the Converters Ink Company located in Linden, New Jersey, requested a hazard evaluation at that facility following several reports of strong odors and illness among the workers. The symptoms included fever, weakness, chills, headache and chest discomfort. The study narrowed down the cause to a water aerosol from the Fade-Ometer machine. Questionnaires, pulmonar function tests, serum precipitin tests, and fungal cultures identified the illness among 14 workers as humidifier lung, a type of hypersensitivity pneumonitis. While the antigen for this illness was not determined, it was contained in stagnant water from the humidifier in the machine. Highly specific results were obtained using a gel diffusion test for serum precipitins to the stagnant water. The authors' recommendations include: institution of a continual flow of water through the humidifier system in this machine; draining of water from the machine at least once a month and cleaning of the surfaces with a bacteriostatic and fungistatic solution; addition of an algicide to the Fade-Ometer water to reduce the presence of organic matter; and monitoring of illnesses among laboratory personnel.

4300 (PB—87-222584/XAB) Industry-wide studies report of industrial hygiene surveys at the Ciba-Geigy Corporation, Toms River, New Jersey. Hills, B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 20p. (IWS—093.26). NTIS, PC A02/MF A01.

Personal and area samples were collected at each step during the production of a dye batch, except during the removal of the wet cake from the filter press, at the CIBA-Geigy Corporation located in Toms River, New Jersey. All personal monitoring was conducted for o-dianisidine dyes, and the area monitoring was performed for o-dianisidine dyes and total dust. Airborne total dye concentrations as high as 1.64 mg/cu m were generated during the processing of dry dye. However, these were brief excursions occurring adjacent to the process equipment. The operators were required to wear respiratory protection while handling the dye. Air concentrations of dye at work stations next to the blending and grinding of the dye were below 0.24 mg/kg. These operators also wore respiratory protection. The unreacted or free o-dianisidine in the dye C.I.-Direct-Black-91 being processed during the survey was about 11 parts per million. The author recommends that biological monitoring be performed on the workers to obtain more accurate exposure data. Biological monitoring of urine would detect the metabolite of benzidine congener dyes.

4301 (PB—87-222808/XAB) Dioxin Registry Report. Report prepared by review documents from Diamond Shamrock Corporation, Diamond Alkali Company, Newark, New Jersey. Marlow, D.; Fingerhut, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 55p. (IWS—117.16). NTIS, PC A04/MF A01.

Occupational exposure to polychlorinated dibenzo-p-dioxins, and in particular 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and hexachlorodibenzo-p-dioxin (HxCDD) isomers, were investigated and compiled in the Dioxin Registry. The Diamond Alkali Company's facility, located in Newark, New Jersey, was one of 14 sites included in the Dioxin Registry. From 1951 to 1969, sodium-2,4,5-trichlorophenate, and 2,4,5-trichlorophenoxyacetic-acid, esters, and amines were produced at this site. All were contaminated with 2,3,7,8-TCDD. Operators involved in the production of sodium-2,4,5-trichlorophenate had potential exposures to 2,3,7,8-TCDD while operating the autoclave reactor, collecting samples from the reactor, operating the dilution/filtration product recovery system, and operating the anisole still and product-recovery system. The 2,3,7,8-TCDD concentrations associated with the autoclave reactor, dilution filtration, and anisole still were about 20, 10, and 70 microgram/gram (microg/g), respectively.

4302 (PB—87-222881/XAB) Industrial hygiene walk-through survey report of Industrial Heating and Finishing Co., Inc., Pelham, Alabama. McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 12 May 1987. 17p. (IWS—157.22). NTIS, PC A02/MF A01.

In an effort to gather information on the potential occupational exposures to acrylates or methacrylates, a walk-through survey was conducted at the Industrial Heating and Finishing Facility in Pelham, Alabama. At this facility, finishing systems were processed for wood, plastic, glass, and metal substrates. Acrylic coatings have been used there since 1982. Coatings were blended at this site with catalysts, solvents and photoinitiators to prepare the needed sprays. At the site, the company used a spray booth and an ultraviolet curing unit connected by a conveyor system to demonstrate spray-coat applications on three dimensional objects to potential clients. During these demonstrations the spraying was done by hand. However, during normal operations, an automated spraying system was incorporated. The spraying was done in a separate room which was equipped with a ventilation system. The facility did not have an industrial-hygiene program, but material safety data

sheets were posted in areas where the materials were used. There have been no health problems reported at this location.

4303 **(PB—87-222949/XAB) Role of nitrogenous pollutants in the formation of atmospheric mutagens and acid deposition. Final report, 22 January 1985-21 April 1987.** Winer, A.M.; Atkinson, R.; Arey, J.; Biermann, H.W.; Harger, W.P. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Mar 1987. 348p. NTIS, PC A15/MF A01.

Three field studies were conducted in the California South Coast Air Basin to provide information concerning the relative importance of atmospheric transformations and sampling artifacts in determining the mutagenic burden in California's atmospheres, and generate in-situ, quantitative, and interference-free measurements of the ambient concentrations of HONO, NO_2, HNO_3, NH_3, and NO_3 radicals (as well as HCHO) which could serve as benchmark data for comparison with other less specific analytical methods participating in the CARB-sponsored Nitrogen Species Measurement Method and Carbonaceous species methods Comparison Studies. The major findings were that, in the South Coast Air Basin, a significant portion of ambient-particulate mutagenicity can be accounted for by a relatively few highly mutagenic nitroarenes which are largely atmospheric reaction products, rather than directly-emitted species.

4304 **(PB—87-222972/XAB) Summary plant observation report and evaluation for ketones.** (SRI International, Menlo Park, CA (USA). Center for Occupational and Environmental Safety and Health). 1977. 65p. NTIS, PC A04/MF A01.

Site visits were made at two ketone production facilities, the Union Carbide facility at Institute, West Virginia, and the Tennessee Eastman facility at Kingsport, Tennessee, to observe procedures for handling these compounds. Labels and warning placcards were used in each facility. Routine use of personal protective equipment in general consisted only of eyeglasses and safety shoes. Protective aprons, coats, gloves, and face shields were available as needed. Safety training and educational programs were in place at each company. Handling of ketones specifically involved primarily pipe and vessel entry, spill containment and handling, and fire-fighting procedures. Preplacement and periodic medical examinations were required except for workers exposed to acetone, which was considered safe. Housekeeping and sanitation facilities were in keeping with the manufacture of flammable and moderately toxic liquids. Samples of air quality were routinely taken at each facility with charcoal tube and gas-chromatography methods being used. The report included flow charts of the production processes, medical-examination forms, preplacement medical examination history report, examples of warning labels, information provided on the hazards of the chemicals being used, hazardous work permits, and results of air sampling tests.

4305 **(PB—87-223186/XAB) Health-hazard evaluation report HETA 85-449-1781, COSCO, Inc., Columbus, Indiana.** Hartle, R.W.; Albrecht, W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 32p. (HETA—85-449-1781). NTIS, PC A03/MF A01.

A health evaluation was requested by employees at COSCO Inc., Columbus, Indiana, concerning exposures to hazardous materials in the spray-paint area, silk screening, welding, plastic regrind, press area, router area, and plating department. The facility was engaged in the manufacture of juvenile and household furniture. Employees had complained of eye, nose, and throat irritation plus skin rashes and a burning sensation on the lips among the heat-seal department employees. The study showed that one heat-seal operator was exposed in excess of the OSHA standard for radiofrequency energy waves of 10 milliwatts/cm^2. Breathing-zone monitoring of welders indicated that one of them was exposed to excessive levels of airborne nickel at 37 $\mu g/m^3$ (NIOSH Recommended Exposure Limit of 15 $\mu g/m^3$). The authors recommend that either the manufacturers of the heat-sealing devices or a private consultant be contracted to reduce the exposure from these machines. One traditional method would be through shielding. An improvement in the ventilation system at the welding area would solve the problem of nickel exposure. General recommendations include avoidance of disposing of solvent soaked rags in a noncovered receptacle and not using solvents as general cleaning compounds, particularly for hand cleaning prior to breaks or at the end of the shift.

4306 **(PB—87-223194/XAB) Health-hazard evaluation report HETA 85-493-1786, Niagara Mohawk Power Corporation, Lycoming, New York.** Cantor, F.L.; Gorman, R.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 30p. (HETA—85-493-1786). NTIS, PC A03/MF A01.

The International Brotherhood of Electrical Workers requested an evaluation of possible harmful occupational exposure to aluminum silicate ceramic fibers (CF) in a stress relief operation at Niagara Mohawk Power Corporation Unit-II, in Lycoming, New York. Stress relief operations were carried out by the Stone and Webster Engineering Corporation. Airborne fiber concentrations ranged from 0.07 to 0.31 fibers/cm^3. Fibers were 4 microns or less in diameter and fell mainly in the 0.5- to 2.0-micron range. The majority of the fibers were of respirable size. No cristobalite was found in any of the air samples. The identified fibers were mainly amorphous materials. Air and bulk samples contained primarily aluminumum, silicon, and titanium. The identified fibers were aluminosilicate. In 1985, the electricians began using personal protective equipment when handling the insulating blankets. The authors conclude that there is insufficient data available regarding CF, but that it would be prudent to minimize exposures to the extent feasible. The authors recommend that the use of personal protective equipment be continued. Medical surveillance should be carried out on all workers exposed to ceramic fibers. Routine x-ray studies are not recommended.

4307 **(PB—87-223210/XAB) Health-hazard evaluation report HETA 86-030-1785, Vimar Corporation, Boulder, Colorado.** Pryor, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 13p. (HETA—86-030-1785). NTIS, PC A02/MF A01.

A representative of Vimar Corporation located in Boulder, Colorado, requested an investigation of occupational exposure to cyanide at the facility during a brightening process used for treating jewelry. During the study, air-monitoring and wipe samples were taken in and around the glove box used for the process. During the process, sodium cyanide and hydrogen peroxide interact to etch the jewelry and bomb the material surface, yielding a brighter finish. Air samples did not indicate cyanide at levels that would be hazardous to workers. Levels were recorded at 0.003 to 0.004 $\mu g/m^3$. Wipe samples did indicate the possibility of exposure through the skin, which can be resolved through good housekeeping practices. The author recommends that the ventilation system should be reviewed annually, personal protective clothing should be provided for employees when working where the cyanide is stored and used, and safety goggles and face shields should be used.

4308 **(PB—87-223228/XAB) Health-hazard evaluation report HETA 86-162-1782, Continental Refrigeration Corporation, Exton, Pennsylvania.** Ruhe, R.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 21p. (HETA—86-162-1782). NTIS, PC A02/MF A01.

A request was made for a hazard evaluation at the Continental Refrigeration Corporation in Exton, Pennsylvania, to determine possible worker exposure to welding fumes and other materials used in foam filling, assembly and crating operations, including solvents and carbon monoxide. Personal breathing-zone air samples were analyzed for particulates, aluminum, iron, zinc, toluene, petroleum distillate, methylene chloride, methyl ethyl ketone, and methylene bisphenyl diisocyanate (MDI). Exposures to methylene chloride ranged from 29 to 213mg/cu m. No overexposures were registered for welding fumes, solvents, MDI or carbon monoxide during these sampling periods. The author concludes that a potential hazard exists from methylene chloride exposure. According to the author, the level of methylene chloride should be lowered through substitution with a less-hazardous process material, automation, ventilation, improved work practices or a combination of these steps. Some lowering of carbon monoxide levels would be achieved through better design criteria of the lift-truck ventilation system and modifications of facility operations in this regard.

4309 (PB—87-223822/XAB) Preliminary studies with a two-dimensional model using transport fields derived from a GCM. Technical paper. Enting, I.G.; Mansbridge, J.V. (Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research). 1987. 51p. (TP—14). NTIS, PC E04/MF E04.

The report describes some preliminary studies with a new two-dimensional atmospheric transport model. The transport fields were obtained from numerical experiments on a three-dimensional general-circulation model and are not subjected to any tuning or calibration process. The model is used to study the distribution of CCl_3F, CO^2 and ^{14}C in the atmosphere. It is found that the model's representation of the distribution of CCl_3F in the troposphere is unsatisfactory. This is attributed to the excessively high tropical tropopause in the original GCM.

4310 (PB—87-224333/XAB) Atmospheric acid deposition damage to paints. Environmental research brief. Haynie, F.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jan 1986. 11p. (EPA—600/M-85/019). NTIS, PC A02/MF A01.

Available data from laboratory and field studies of damage to paints by erosion were analyzed to develop an atmospheric acid-deposition damage function for exterior house paints containing calcium carbonate or silicate extenders. Regression-analysis coefficients associated with sulfur dioxide levels are consistent with the reaction between the SO_2 and calcium carbonate to form soluble calcium sulfate. The effect of sulfuric acid in rain on paint is expected to behave similarly. Observed actual household painting frequencies prior to 1970 are consistent with the damage functions calculated from the experimental erosion data obtained in the 1950's, 1960's and early 1970's. Changes in both environmental conditions and types of paints marketed make it necessary to make assumptions when using the damage functions to estimate costs associated with repainting.

4311 (PB—87-227047/XAB) Prevention reference manual: chemical specific. Volume 1. Control of accidental releases of hydrogen fluoride (SCAQMD) (South Coast Air Quality Management District). Final report, May 1986-March 1987. Davis, D.S.; DeWolf, G.B.; Quass, J.D. (Radian Corp., Austin, TX (USA)). Jul 1987. 125p. (DCN—87-203-024-84-21). NTIS, PC A06/MF A01.

This manual summarizes technical information that will assist in identifying and controlling hydrogen fluoride release hazards specific to the South Coast Air Quality Management District (SCAQMD) of southern California. The SCAQMD has considered a strategy for reducing the risk of a major accidental air release of toxic chemicals. The strategy includes monitoring the storage, handling, and use of certain chemicals and provides guidance to industry and communities. Anhydrous hydrogen fluoride, a corrosive liquid that boils at room temperature, rapidly absorbs moisture to form highly corrosive hydrofluoric acid. Hydrogen fluoride gas has an IDLH (immediately dangerous to life and health) concentration of 20 ppm, which makes it a substantial acute toxic hazard. Reducing the risk associated with an accidental release of hydrogen fluoride involves identifying some of the potential causes of accidental releases that apply to the processes that use hydrogen fluoride in the SCAQMD. The manual identifies examples of potential causes as well as measures that may be taken to reduce the accidental-release risk.

4312 (PB—87-227054/XAB) Prevention reference manual: chemical specific. Volume 2. Control of accidental releases of chlorine (SCAQMD) (South Coast Air Quality Management District). Final report, May 1986-March 1987. Davis, D.S.; DeWolf, G.B.; Quass, J.D.; Wert, K.P. (Radian Corp., Austin, TX (USA)). Jul 1987. 131p. (DCN—87-203-024-84-23). NTIS, PC A07/MF A01.

This manual discusses reducing the risk associated with an accidental release of chlorine. It identifies some of the potential causes of accidental releases that apply to the processes that use chlorine. It also identifies examples of potential causes, as well as measures that may be taken to reduce the accidental release risk. Such measures include recommendations on: plant design practices; prevention, protection, and mitigation technologies; and operation and maintenance practices. It provides conceptual cost estimates of possible prevention, protection, and mitigation measures. Chlorine is a highly reactive and corrosive liquid that boils at room temperature. It has an IDLH (immediately dangerous to life and health) concentration of 25 ppm, which makes it a substantial acute toxic hazard. Accidental releases of toxic chemicals at Bhopal and Chernobyl have increased public awareness of toxic-release problems. As a result of other, perhaps less-dramatic incidents in the past, portions of the chemical industry were aware of this problem long before these events. These same portions of the industry have made advances in the area.

4313 (PB—87-227062/XAB) Prevention reference manual: chemical specific. Volume 3. Control of accidental releases of hydrogen cyanide (SCAQMD) (South Coast Air Quality Management District). Final report, May 1986-March 1987. Davis, D.S.; DeWolf, G.B.; Quass, J.D. (Radian Corp., Austin, TX (USA)). Jul 1987. 89p. (DCN—87-203-024-84-24). NTIS, PC A05/MF A01.

This report discusses a strategy (being considered by the South Coast Air Quality Management District–SCAQMD–of Southern California) for reducing the risk of a major accidental air release of toxic chemicals. The strategy, intended to guide both industry and communities, consists of monitoring activities associated with the storage, handling, and use of certain chemicals. The hydrogen cyanide (HCN) manual summarizes technical information that will aid in identifying and controlling release hazards (specific to the SCAQMD) associated with HCN. Because HCN has an IDLH (immediately dangerous to life and health) concentration of 50 ppm, it is an acute toxic hazard. The manual identifies the potential causes of accidental releases that apply to processes using cyanides in the SCAQMD and also describes measures that may be taken to reduce the accidental-release risk. Such measures include recommendations on plant design practices; prevention, protection, and mitigation technologies; and operation and maintenance practices. Conceptual cost estimates of examples of these measures are provided.

4314 (PB—87-232112/XAB) Prevention reference manual: user's guide overview for controlling accidental releases of air toxics. Final report, May 1986-March 1987. Davis, D.S.; DeWolf, G.B.; Quass, J.D. (Radian Corp., Austin, TX (USA)). Jul 1987. 173p. (DCN—87-203-023-62-17). NTIS, PC A08/MF A01.

The User's Guide, the first in a series of manuals, presents an overview of available methods for identifying, evaluating, and controlling hazards in facilities that use, manufacture, or store acutely toxic chemicals that could be released into the environment. Hazardous chemicals and their key characteristics are discussed, followed by a discussion of the potential hazards in process and physical-plant design and in operational procedures. Formal methods of hazard identification and evaluation are discussed, their major features are compared, and an overview of control principles for prevention, protection, and mitigation is presented. Examples of control technologies are listed, and an example guide for inspecting facilities is presented. Important references on the topic of accidental toxic chemical release prevention are cited.

4315 (PB—87-233318/XAB) Sampling and analytical methods development for dry-deposition monitoring. Final report, December 1983-March 1987. Sickles, J.E.; McClenny, W.A.; Paur, R.J. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1987. 223p. NTIS, PC A10/MF A01.

Acid deposition is the transfer of acidic substances to the earth's surface by wet or dry deposition. Dry deposition includes all processes by which airborne contaminants are removed from the atmosphere at the earth's surface, excluding those processes directly aided by precipitation, and contributes substantially to the acidic deposition burden. The U.S. Environmental Protection Agency (EPA) plans to implement a dry-deposition monitoring network. The constitutents of interest are HNO_3, NO_3, SO_2, NH_3, NH^{4+}, NO^{3-}, $SO_4(2-)$, H^+ (acidity), and O_3. The objective of the current research is to investigate sampling and analysis methods for these

constituents to identify those methods that appear most promising for network deployment. The culmination of the current project is a field study conducted in the Research Triangle Park, North Carolina between August and December of 1986. The main objectives of the study were to conduct measurements of selected airborne gaseous and particulate acidifying species using different types of samplers and to evaluate the differences observed under field-sampling conditions.

4316 **(SRD/HSE/R—396) Thermodynamics of mixing and final state of a mixture formed by the dilution of anhydrous hydrogen fluoride with moist air.** Clough, P.N.; Grist, D.R.; Wheatley, C.J. (UKAEA Safety and Reliability Directorate, Culcheth). Jan 1987. 52p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth, Warrington, WA3 4NE. Order Number TI88900114/JAW.

Work performed under UKAEA Fast Reactor Exchange Program.

This work describes a chemical thermodynamic treatment of mixtures of anhydrous hydrogen (AHF) with varying fluoride quantities of moist air which enables the final equilibrium state of the mixture to be defined, subject to an assumption of adiabaticity. The treatment has been incorporated in a computer code, WETAHF, which can calculate various properties of the mixture such as temperature, density, and fraction of HF in aerosol form, as a function of air mixing ratio and relative humidity. The code has been applied to a number of starting conditions which might be associated with accidental releases of bulk-stored AHF. The results show that for most starting conditions, the HF-water vapor interaction strongly influences the properties of mixtures for mixing ratios in the range 10 to 1000. In particular, aerosol is predicted to be a significant contributor to the total HF present, and the mixtures are predicted to be buoyant within specific ranges of mixing ratio. The implications of these results with respect to the toxicological and dispersion properties of hydrogen fluoride clouds in the atmosphere are discussed. 25 refs., 21 figs., 2 tabs.

4317 **(SRD-R—307) A modelling study of dispersion of elevated plumes at a coastal location during onshore flow.** Cooper, P.J.; Nixon, W.; Ghobadian, A. (UKAEA Safety and Reliability Directorate, Culcheth). Jan 1987. 38p. United Kingdom Atomic Energy Authority, Warrington, England WA3 4NE. Order Number TI88900115/JAW.

Work performed under United States-UKAEA Fast Reactor Exchange Program.

Dispersion of pollutant from an elevated release is modelled using an atmospheric turbulence model, APT, (Atmospheric Pollutant Transport). The dispersion behavior at both coastal and inland locations is considered for a variety of atmospheric conditions. The results are used to identify those conditions which give a marked difference in air concentrations for the two locations. Some of these occasions correspond to 'fumigation' conditions for which modified Gaussian models have been proposed; for these conditions, the predictions of the simple models are compared with those of APT. The implications of the comparison for applications using these Gaussian based models is discussed.

4318 **(UCRL—95936) Rising CO_2 and climate change.** MacCracken, M.C. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 5p. (CONF-8709149—1). NTIS, PC A02. Order Number DE88000752/JAW.

From 8. conference on biometeorology and aerobiology; West Lafayette, IN, USA (15 Sep 1987).

The report discusses general circulation models (GCM's) of the earth's climate as they replicate and predict climatic changes caused by increases in the concentration of carbon dioxide and other greenhouse gases. (ACR)

4319 **(VW-FMT—8402N/3) Manganese concentrations in air resulting from the possible use of manganese compounds as a Diesel fuel additive and health effect aspects of manganese.** Kuhler, M.; Kraft, J.; Hertel, R.F. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.); Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)). 13 Mar 1984. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750143/JAW.

Before introducing manganese containing additives for Diesel fuel, it is necessary to estimate the manganese concentrations in ambient air which are to be expected and to compare these concentrations with threshold values for possible adverse health effects. A literature search for health effects made by the Fraunhofer Institute (FhG) is integrated as part 2 of this report. The highest concentrations will occur along highways and in street canyons. Therefore, dispersion calculations were made for both situations. For a hypothetical car inventory of 100% Diesel cars as the worst case the manganese concentrations along highways and in street canyons during rush hours will be about a factor of more than 100 lower than the threshold limit value (TLV) for manganese tetroxide. The real manganese concentrations will be a factor of thousand below the TLV of 1 mg Mn/m/sup 3/ because a fraction of 10% of the light duty car inventory is a more realistic assumption for the Diesel car population and because a considerable amount of manganese is retained on the particle filter.

4320 **(WU/IRI—8703) Assessment of mercury emissions from the incinerator stack at Quirk Creek sour gas plant.** Gnyp, D.; Gnyp, A.W.; Viswanathan, S. (Windsor Univ., Ontario (Canada). Industrial Research Inst.). Mar 1987. 24p. (MICROLOG—87-03794). Alberta. Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Five source sampling tests failed to confirm the high concentration of mercury that was determined once during a previous trace element emission study at the Esso-Quirk Creek sour gas plant. At the present time, the anomalous result cannot be explained adequately. A maximum emission rate of 0.50 +/- 0.03 grams of mercury per hour has been estimated assuming that, under worse case conditions, mercury can be present in the incinerator stack emissions at limit of detection concentrations. Emission rates of mercury of this magnitude have been predicted for several other plants where the presence of the metal was not established since it was not detected in more than one-half of the tests or once at a concentration exceeding the limit of detection by a factor of three. 2 tabs.

4321 **Indoor air and human health: Major air pollutants and their health implications.** Gammage, R.B. (Ed.); Kaye, S.V. (Ed.). Chelsea, MI; Lewis Pub. (1986). 430p. Lewis Publishers, 121 South Main St., P.O. Drawer 519, Chelsea, MI 48118.

This book provides information about indoor air pollution, a principal air pollution source. The Consumer Federation of America reports that indoor air pollution costs the U.S. up to $100 billion annually in medical expenses and lost production, and it accounts for up to half of all illness in the United States each year. This book from a life Sciences Symposium includes discussion of indoor air and human health, measurement and source characterization, habitat studies, health effects, risk analysis and future needs.

4322 **Indoor air quality.** Walsh, P.J. (Ed.); Dudney, C.S.; Copenhaver, E.D. Boca Raton, FL; CRC Press Inc. (1983). 216p. CRC Press Inc., 2000 Corporate Blvd. NW, Boca Raton, FL 33431.

In this book the nature and sources of indoor air pollution, methods for measuring pollutant concentrations, and health effects of energy conservation methods on indoor air quality are examined in detail. Specific pollutants such as formaldehyde, radon, carbon monoxide, nitrogen dioxide, organics, respirable particulates, allergens and pathogens are also discussed.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 2997, 3017, 3504, 4317, 4369, 4498

4323 (CONF-841142—, pp 157-192) **Transuranic resuspension.** Sehmel, G.A. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The objective of this chapter is to summarize plutonium and americium resuspension research conducted by the Pacific Northwest Laboratory from 1977 to 1983. Airborne plutonium was determined at five sites in the Hanford area, and both plutonium and americium were determined at two sites. Concentrations of airborne plutonium and americium were examined as a function of aerodynamic particle diameter, sampling height, wind speed increments, and wind direction increments. The following results are discussed: airborne radionuclide concentrations, $^{+}Ci/cm^{3}$ of sampled air; radionuclide activity densities, $\mu Ci/g$ of airborne solids; airborne plutonium fluxes, $\mu Ci/(m^{2}d)$; $^{241}Am//sup\ 239,240/Pu$ activity ratios, ($\mu Ci\ ^{241}Am)/(\mu Ci$ /sup 239,240/Pu); and airborne solid concentrations, $\mu\ g/m^{3}$ of sampled air. In addition, a relationship based on field data for aged plutonium sources at Bikini Atoll, the Hanford site, and Rocky Flats was developed to estimate the maximum expected plutonium activity density on airborne solids compared to activity densities for bulk surface-soil samples. As a result, it is possible to more accurately predict resuspension factor ranges as a function of the resuspension source activity densities. 31 references, 18 figures, 5 tables.

4324 **(CONF-871101—59) Impact of the Chernobyl accident on Turkey.** Fields, D.E.; Ozluoglu, N.; Yalcintas, M.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013876/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

In this paper, we present and discuss measurements of radionuclide concentrations made in Turkey during the Chernobyl event and perform preliminary analyses of the internal and external doses associated with exposure to these materials. 15 refs., 1 tab.

4325 **(CONF-871202—1) US NRC emergency response dose assessment model.** Sjoreen, A.L.; Athey, G.F.; Sakenas, C.A.; McKenna, T.J. (Oak Ridge National Lab., TN (USA); Phoenix Associates, Bethesda, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014793/JAW.

From 21. mid-year meeting of the Health Physics Society: power reactor health physics; Miami Beach, FL, USA (12 Dec 1987).

A new IBM PC-based dose assessment model has been written to replace the IRDAM model for use during response to emergencies. It is fast, very simple to use, and easy to modify, with separate modules of the source term, atmospheric transport, and dose models. The source term can be estimated based on isotopic ratios or on recently developed procedures that depend only on gross plant conditions. The atmospheric transport and dose models have been adapted from MESORAD. The transport model is a combination of a Lagrangian puff and Gaussian plume dispersion models. Doses are computed for whole body, lung, and thyroid for each grid location. 8 refs.

4326 (IAEA-RL—147, pp 37-46) **Analysis of Chernobyl debris performed at the Pacific Northwest Laboratory of the USDOE.** Perkins, R.W. Jul 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW. (CONF-8609348—).

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

The data presented in this paper compare airborne Chernobyl radionuclide concentrations observed at Richland, Washington, USA, with those observed in Stockholm, Sweden. The data also include elemental and radionuclide concentration of "hot particles". Tabs and figs.

4327 **(INIS-mf—10730) 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.** (Niedersaechsisches Inst. fuer Radiooekologie (Germany, F.R.)). 1987. 132p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

The research and development projects deal with the HTO exchange within the system of atmosphere/soil, with the conversion of HT to HTO/OBT in the soil, with the determination of Sr-90 and Cs-137 in environmental samples and with a stock taking of I-129 in human thyroids. Additional studies following the Chernobyl accident concern the determination of transfer factors, enrichments and migration of fission products or uranium. The research programme is supplemented by aerophysical studies, special radioecological issues (aerosol determination, washout, deposition, dispersion) and by the non-destructive biomass assay using gamma rays and microwaves.

4328 (INIS-mf—10730, pp 19-25) **HTO exchange in the atmosphere-soil system.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The transition of water vapour from the atmosphere to the soil water can be described by the vapour transport from the surface layer of the atmosphere into the air contained in the soil pores (gas exchange) and by the condensation of pore-air moisture on to the soil matrix (phase conversion). The theoretical analyses and the fundamentals studied are used to develop a model of HTO exchange between the atmosphere and the soil and of the associated diffusion processes in the soil.

4329 (INIS-mf—10996, pp 47-48) **Determination of radioactive isotopes from the Chernobyl accident in Vienna.** Friedmann, H.; Hernegger, F.; Wagner, M.; Weselka, D.; Wild, E. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4330 (INIS-mf—11002, pp 57-63) **Method for measuring Kr-85 concentration in the atmosphere and results of measurements carried out in Hungary.** Chongor, E. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Kr-85 sources and their contributions to its content in the atmosphere are described. A measuring technique for Kr-85 concentration in the atmosphere is suggested based on beta activity detection. The measuring results obtained in Hungary within 1966-1982 are presented. Probable causes of Kr-85 concentration variations, speed of its global spreading and impact on people health are discussed. 12 refs.; 2 tabs.; 3 figs.

4331 **(JAERI-M—86-187) Field experiment and wind tunnel experiment of atmospheric dispersion supporting the development of emergency response system.** (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 119p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700058/JAW.

This report contains papers on emergency research carried out under "Subcommittee for Field Experiment and Wind Tunnel Experiment of Atmospheric Dispersion" organized by JAERI from 1981 through 1985. The purpose of this subcommittee is to obtain the experimental data for atmospheric dispersion and to aid the development of a computer code system to predict environmental consequences due to accidental release, which has been carried out under "Subcommittee for the Monitoring and Prediction of Radionuclides Accidentally Released into Atmosphere". As for the field experiments, tracer experiments and intensive wind observations were carried out in the coastal terrain during the first four years. In the following two years, the experiments were carried out in the complex terrain, around Mt. Tsukuba. The wind tunnel experiments contain the experiments on a flat plate and on topographic models

of Tokai-mura, Shimane or Mt. Tsukuba. The experiment within the unstable stratification was also performed. The data obtained by these experiments were used for the development of the computer code system.

4332 (PTB-SE—14, pp 257-267) **Sorption of Cs, Sr, Ce, and I by samples from the overlying rock of the Gorleben salt dome.** Steinkopff, T.; Kerschgens, A.; Vadola, D.; Lieser, K.H. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

By means of shaking experiments the following data have been obtained: R/sub S/(Cs) = 0.1-230 ml/g; R/sub S/(Sr) = 0.2-4.0 ml/g; R/sub S/(Ce) = 3-130 ml/g; R/sub S/(I) = 0.05-40 ml/g. Cesium and strontium are present as ion disperse Cs/sup +/ and Sr/sup ++/, and sorption mainly proceeds by ion exchange. In the groundwater pH-range between pH 5 and pH 8 the effect of colloids is observable, especially for cerium. Iodine is present as I/sup -/ under anaerobic conditions, and undergoes almost no sorption (R/sub S/ < 0.1 ml/g). High sorption values are attributed to the presence of organic material.

4333 **(SCPRI-RM—1-1987) Monthly results of measurements, January 1987.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Feb 1987. 53p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750084/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, cattle thyroids, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident, in various food samples.

4334 **(SCPRI-RM—3-1987) Monthly results of measurements, March 1987, with supplement related to 1987 first quarter.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Apr 1987. 75p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750461/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, undergroung water, sewage water, drinking water, food chain (milk, vegetables, fishes) sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

4335 **(UCRL—96709) Radioactive fallout from the Chernobyl nuclear reactor accident.** Beiriger, J.M.; Failor, R.A.; Marsh, K.V.; Shaw, G.E. (Lawrence Livermore National Lab., CA (USA); Alaska Univ., Fairbanks (USA). Geophysical Inst.). Aug 1987. Contract W-7405-ENG-48. 6p. (CONF-871061—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE87014349/JAW.

From 33. annual bioassay analytical and environmental radiochemistry conference; Livermore, CA, USA (6 Oct 1987).

This report describes the detection of fallout in the United States from the Chernobyl nuclear reactor accident. As part of its environmental surveillance program, Lawrence Livermore National Laboratory maintained detectors for gamma-emitting radionuclides. Following the reactor accident, additional air filters were set out. Several uncommon isotopes were detected at the time the plume passed into the US. (TEM)

4336 **Radon transport into a detached one-story house with a basement.** D'Ottavio, T.W.; Dietz, R.N.; Nazaroff, W.W. (Brookhaven National Lab., Upton, NY, USA; Lawrence Berkeley Lab., CA, USA; California Institute of Technology, US. Environmental Engineering Science). *Atmospheric Environment;* **20**: No. 5, 1065-1067(1986).

Discussion and Author's reply.

The interpretation of the data presented in a paper published in 1985 on radon transport into a detached one-story house with a basement is extended by developing an improved model that can be used to predict radon concentration in this house. In particular, emphasis was placed on a more complete set of replotted sump activity data. In the author's reply, this development is welcomed but two concerns regarding the conclusions one might infer from the analysis are discussed.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 3289, 4176, 4320

5006 Regulations

REFER ALSO TO CITATION(S) 2856, 2859, 2883, 2884, 2885, 2897, 3539, 3664, 4280, 4281, 4544

4337 (CONF-8611194—, pp 25, Paper 1) **Important requirements from the Clean Air Technical Guide.** Haeberlin, A. (Arbeitsgemeinschaft fuer Sparsamen und Umweltfreundlichen Energieverbrauch e.V., ASUE, Frankfurt am Main, Germany, F.R.). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

The author demonstrates the position of the Clean Air Technical Guide within the BImSchG (Federal German Immission Control Act), its structure and scope, while focussing on the emission limit levels pertinent to the gas industry, on retrofitting requirements on old plants, and on the staggered periods of transition. In addition, he discusses the state of the art of technology and dynamization clauses, compensation, mixed combustors, multifuel combustors, stand-by and peak-load boilers, 'shared plant', continuous measurement. (HSCH).

4338 (CONF-8611194—, pp 23, Paper 5) **Impact of the Clean Air Technical Guide on process furnaces in the industries of nonmetallic minerals, glass, ceramics, building materials, and non-ferrous metals.** Holle, T. (Ruhrgas A.G., Essen, Germany, F.R.). Nov 1986. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750137/JAW.

From Technical meeting: TA Luft (Clean Air Technical Guide) - is it a chance for natural gas; Nuernberg, F.R. Germany (26 Nov 1986).

The additional requirements made by the Clean Air Technical Guide on thermal process plants cannot be generalized but necessitate an individual case analysis owing to the fact that emissions greatly depend from the raw materials and processes involved. The fuel-specific and combustion-technological advantages of natural gas allow plants to be designed for optimum production and energy utilization. The fierce competition in the different industries may be expected to result in innovative process-technology solutions in the years to come which will be preferably implemented with natural gas. (orig./HSCH).

4339 **(GAO/RCED—86-94) Air pollution: Improvements needed in developing and managing EPA's air quality models.** (General Accounting Office, Washington, DC (USA)). 1986. 33p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Limitations in the current state of the art of air quality model development have produced pollution concentration estimations with wide ranges of uncertainties. In some situations, the

ranges are so wide that EPA officials must perform additional analyses before making regulatory decisions. EPA recognizes it needs more and better models. However, after several years of development, EPA still does not have all the models, or refined enough models, it needs to regulate various pollutants over different terrains in the United States. EPA is assessing the precision of its existing models in order to quantify the uncertainties of each model's estimations. GAO believes that this assessment process is desirable and an important step in helping EPA in carrying out the objectives of the Clean Air Act, including improving the usefulness of models.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 4269

5101 Basic Studies

REFER ALSO TO CITATION(S) 4354

4340 (DOE/ER/60459—1) **Semi-arid ecosystem development as a function of resource processing and allocation: Progress report for period June 1, 1986-May 31, 1987.** Redente, E.F. (Colorado State Univ., Fort Collins (USA). Dept. of Range Science). Sep 1987. Contract FG02-86ER60459. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000890/JAW.

Most studies of ecosystem development focus on the primary producers. This results in useful but restricted views of secondary successional processes. A more complete understanding of ecosystem development requires integrated study examining the primary producers, microflora and abiotic compartments of the system. This study focuses on the interrelationships between above- and belowground processes in semi-arid ecosystem development. We have examined primary production as well as decomposition, plant competition and changes in soil resource pools. Our main hypotheses link aboveground community structure to soil biological activity, development of the rhizosphere and mycorrhizal associations. Added to this are studies in plant life history strategies as well as physiological diversity of microorganisms to assure a more comprehensive understanding of secondary succession in semi-arid ecosystems.

4341 (INIS-mf—10996, pp 43-44) **Radon measurements for earthquake prediction research.** Aric, K.; Gutdeutsch, R.; King, C.Y.; Altay, C.; Sav, H.; Friedmann, H.; Hernegger, F. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna, Austria; Geological Survey, Menlo Park, CA, USA. Office of Earthquake Studies; Maden Tetkik ve Arama Enstitusu, Ankara, Turkey). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4342 **Introduction to environmental science. Second edition.** Moran, J.M.; Morgan, M.D.; Wiersma, J.H. New York, NY; W.H. Freeman and Company Publication (1986). 709p. W.H. Freeman and Co. Publication, 41 Madison Ave., New York, NY 10010. Contract AC05-84OR21400.

From review by D.W. Johnson, Oak Ridge National Lab., in J. Environ. Qual., Vol. 16, No. 1 (1987).

This book presents an overview of today's major environmental issues. It is organized into three parts - Part I: Concepts of Ecology; Part II: Environmental Quality and Management; and Part III: Fundamental Problems: Population, Food, and Energy. The complex issue of acid rain is only briefly discussed. The economic aspects of environmental regulation are covered where they are applicable. The breadth of the topics covered also leads to some omissions. However, in general, environmental issues seem to be treated objectively in this volume.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 3459, 4283

4343 (GAO/RCED—86-204) **Hazardous waste: EPA's Superfund Program improvements result in fewer stopgap cleanups.** (General Accounting Office, Washington, DC (USA)). 1986. 30p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency has designated over 800 hazardous waste sites as priority sites, and expects that list to grow to about 2,000. In 1985, GAO reported that EPA's actions to address immediate and significant hazards at priority sites resulted in the worst hazardous waste sites receiving only stopgap cleanups, leaving hazardous substances on the surface and requiring repeated stopgap actions at additional cost. In this followup report, GAO found that EPA has taken 43 repeat actions in the last two years. Most of these resulted from inadequate or incomplete removal actions during the first three years of the program (1981-83). Only seven repeat actions were taken at sites initially addressed since 1984, so EPA appears to be making progress in the use of removal actions. It is too early to determine the effectiveness of EPA's actions, however, because enough time has elapsed since cleanups began, and cleanup activities have been delayed or curtailed due to funding limitations.

4344 (GSF-BPT—8/86, pp 7-18) **Spatial and seasonal variation of the deposition of inorganic substances on soil and spruce. Results of the Hessian WDI project.** Balazs, A.; Hanewald, K. (Hessische Forstliche Versuchsanstalt, Hann Muenden, Germany, F.R. Inst. fuer Forsthydrologie; Hessische Landesanstalt fuer Umwelt, Wiesbaden, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

Deposition rates were measured in spruce forests and in the open country. Matter content of the deposition as sulfates, nitrates, chlorides, sodium, potassium, magnesium and manganese were determined as well as the pH. The results show a significant difference between the two kinds of measuring locations. The dripping water in the forest had a higher concentration of the measured elements than the deposition and its pH was by 0.9 points lower.

4345 (GSF-BPT—8/86, pp 19-24) **Deposition of atmospheric pollutants on forest systems - a quantifying approach using flow balance data of the crown area.** Bredemeier, M.; Matzner, E. (Goettingen Univ., Germany, F.R. Inst. fuer Bodenkunde und Waldernaehrung; Goettingen Univ., Germany, F.R. Forschungszentrum Waldoekosysteme - Waldsterben). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

A model for estimating the element flow in tree-tops is explained. Beginning with the differentiation of different kinds of deposition - 'precipitation-deposition' and 'interception-deposition' - it ends with developing mathematical equations to calculate the element flow of particles, commonly entering forest ecosystems. It is used for the elements H, K, Ca, Mg, Al, Fe, Mn and S.

4346 (GSF-BPT—8/86, pp 25-34) **H-ion deposition in forest ecosystems in Northern Germany.** Meiwes, K.J.; Koenig, N. (Niedersaechsische Forstliche Versuchsanstalt, Goettingen, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

The results of the measurement of H-ion deposition in different forest ecosystems in the northern part of the Federal Republic of Germany in 1982/83 are presented. Deposition by interception is determined with the aid of a model to make an overall assessment

of processes in the area of the crown. The paper discusses the assumptions on which this is based. The results reveal that deposition by interception is a factor bearing heavily on the stress load for forest ecosystems. Owing to the high variability of deposition rates over time, the necessity for conducting measurements over a period of several years is pointed out.

4347 (GSF-BPT—8/86, pp 35-36) **Determination of deposition rates and calculation of material conversions in the crown area of trees in selected forest stands of North-Rhine-Westphalia.** Gehrmann, J. (Landesanstalt fuer Oekologie, Landschaftsentwicklung und Forstplanung Nordrhein-Westfalen, Recklinghausen, Germany, F.R.). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

Deposition with precipitation in the field and in stands, under spruces and partly also under beech stands, is measured in 7 sites in forest areas in the Land North-Rhine-Westphalia. On the one hand the measuring stations are situated both in the medium-range mountains and lowland, on the other hand they are distributed over areas of heavier and less severe damage. Recording of the substances deposited with precipitation and after passage of the crown of trees is done using bulk samplers. The results for the measuring year 1984 showed no constant relation of precipitation deposition in the field to the total amount of precipitation. Deposition of H/sup +/, S, and Cl is largest in the vicinity of sources of emission in lowland and at the measuring stations situated at the highest altitudes in medium-range mountains. Deposition of NH/sub 4/-N is highest where forest areas are surrounded by intensive-farming areas. Whether a stand is in a site protected from immissions or in one that is exposed to immissions bears heavily on the total acid deposition. Finally, the chemical condition of the soil and the vitality of the root system also seem to influence the rate of acid buffering in the crown area and filter capacity against acid gases.

4348 (GSF-BPT—8/86, pp 37-46) **Investigations on wet deposition at the high altitudes of the Southern Black Forest.** Mies, E.; Zoettl, H.W. (Freiburg Univ., Germany, F.R. Inst. fuer Bodenkunde und Waldernaehrungslehre). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

In high-altitude sites in the Southern Black Forest, investigations on the chemical composition of precipitation in the field and precipitation after passage of the crown of trees were carried through. Owing to the emissions in the Rhine valley, the sites at a smaller distance from the Rhine valley receive a clearly higher burden of acid, nitrogen compounds, and heavy metals. Different sodium depositions with precipitations having passed the crown of trees are attributed to the different filtration of fog and cloud water by the stands. As compared to an equal deposition in the field, manganese depositions after passage of tree crowns are much influenced by the ph value of the soil.

4349 (GSF-BPT—8/86, pp 47-56) **Investigations in wet and dry deposition.** Grosch, S.; Georgii, H.W. (Frankfurt Univ., Germany, F.R. Inst. fuer Meteorologie und Geophysik). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

With reference to five sites predominantly situated in the Federal Land Hesse, the fluxes of the elements SO/sub 4//sup 2/, NO/sub 3//sup -/, Cl/sup -/, Pb, Mn, Fe, and Cd caused by wet and dry deposition are presented for the period April 1983 to April 1985. In accordance with earlier investigations, wet deposition constitutes the preponderant source of SO/sub 4/, NO/sub 3/, Cl, Pb and Cd, whereas Fe and Mn are for a large part deposited in dry form. The rates of deposition measured at the three sites situated in forest areas are not much different from the values found for two areas to be described as areas of relatively clean air. Owing to the dry deposition occurring in forest areas, an enrichment of elements in precipitation water having passed the tree crowns takes place. The ratio of element concentrations in precipitation below and above the crowns of trees seems to indicate a dependence on the mean mass diameter of the corresponding aerosol particles.

4350 (GSF-BPT—8/86, pp 57-63) **Deposition of gases and particles.** Dlugi, R. (Muenchen Univ., Germany, F.R. Meteorologisches Inst.). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

This study attempted to determine, with the aid of measurements, the amounts of acid, sulfate, and nitrate formed by heterogeneous processes in a condensing atmosphere. Measurements were carried through at the meteorological measuring tower (height 200 metres). The mast stands in the Rhine valley in a stand of spruce. At different altitudes meteorological data are recorded from which the exchange coefficients can be calculated. Sampling was done at heights of 2 metres, 10 metres, 25 metres, and 100 metres. The experiments showed that, for certain atmospheric conditions and higher pollutant concentrations, one can use the gradient method to calculate vertical fluxes. The results of the different methods are fairly confirmed by each other under the conditions given at the site of measurement. It was found, however, that for numerous measuring days negative gradients are determined, from which no fluxes can be calculated.

4351 (GSF-BPT—8/86, pp 65-81) **Studies in dust deposition in forest stands in the Black Forest and Schoenbuch.** Droescher, F.; Baumbach, G. (Stuttgart Univ., Germany, F.R. Inst. fuer Verfahrenstechnik und Dampfkesselwesen). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

The investigation deals with quantities influencing dust deposition in forest stands. The importance of sedimentation was studied by measurements in a forest-covered valley of medium-range mountains with a local source of emission. Furthermore, airborne-particle measurements were carried through in two forest stands, the Schoenbuch and Freudenstadt forests, both in the southern part of the Federal Republic of Germany, to determine the supply of selected pollutants (S, Ca, Pb, V) forming the constituents of airborne particles for the second half of 1985. Vertical profiles of airborne-particle concentrations, which were also established there, show distinct gradients of concentration only for elements bound to larger airborne particles (Ca).

4352 (GSF-BPT—8/86, pp 82-95) **Measurements of the concentration and deposition of SO/sub 2//SO/sub 4/ in the atmospheric layer close to the soil during the 'TULLA' experiment in March 1985.** Jaeschke, W.; Herbert, F.; McLaren, E.; Sattler, T.; Thomas, J. (Frankfurt Univ., Germany, F.R. Zentrum fuer Umweltforschung). 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750138/JAW. (CONF-8602150—).

From IMA seminar on deposition; Neuherberg, F.R. Germany (25 Feb 1986).

This study was an attempt to determine the dry deposition of SO/sub 2/ in the Rhine valley and at the ridge of the Black Forest by the use of two measuring towers. Measuring towers can provide single-spot data on dry deposition only. The concentration values measured were to allow the development of model approaches with a view to making forecasts on dry deposition in large areas; vice versa the informative value of the prognostic model was to be verified by the determination of dry deposition in individual selected spots. Data to show in how far the figures forecast by the model are in accordance with the rates of deposition measured will soon be available. The work permitted to gather experience as to what different model approaches and measuring techniques can be used in field measurements of deposition, and on the question of how much they are comparable with each other in experiments conducted in parallel.

4353 **(PNL-SA—15066) Statistical approaches to screening hazardous waste sites for toxicity.** Thomas, J.M.; Athey, L.A.; Skalski, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 29p. (CONF-870763—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000087/JAW.

From 3. annual solid waste testing and quality assurance symposium; Washington, DC, USA (14 Jul 1987).

Bioassay results from two field studies illustrate how maps of toxicity can be prepared based on systematic sampling and show how cleanup decisions can be made using bioassay results based on few samples. Logarithmically spaced soil samples were obtained along four parallel transects at the Rocky Mountain Arsenal. A total of 72 soil samples were subjected to Daphnia, Microtox, algal, earthworm and lettuce root elongation bioassays. Bioassay results (excepting earthworms) were inconclusive for toxicity, but allowed us to ignore several classes of compounds, such as water-soluble heavy metals, herbicides, and insecticides, since our prior results using pure chemicals showed depressed algal growth in the presence of these contaminants. To depict the spatial pattern of observed seed mortality at each depth, we used kriging to produce contour maps. The results clearly showed that lettuce seed mortality was higher in the 15 to 30 cm fraction, that waste-trench soil was highly phytotoxic, and that toxicity decreased as a function of distance from the trench. In addition, we found that mortality contours produced by kriging could be useful in site cleanup decisions. A study was conducted using a series of water and sediment samples collected from a narrow stream adjacent to a wood treatment plant in Canton, Mississippi. Both creosote and pentachlorophenol were used for wood treatment. Sediment samples were collected every 20 m in the visibly contaminated zones. Based on simple linear interpolation of bioassay results, we found that different bioassays led to different conclusions regarding the toxicity of different areas, suggesting that contaminants other than creosote may have caused the observed toxicity. Moreover, chemical analysis was an inaccurate predictor of toxicity.

4354 **Mineralization and volatilization of polychlorinated biphenyls in sludge-amended soils.** Fairbanks, B.C.; O'Connor, G.A.; Smith, S.E. (New Mexico State Univ., Las Cruces). *Journal of Environmental Quality;* **16**: No. 1, 18(Jan-Mar 1987).

Polychlorinated biphenyls (PCBs) are toxic organics of concern limiting the reuse of sewage sludge on agricultural lands. The mineralization and volatilization of PCBs (^{14}C-Aroclor 1254) were monitored for 240 d in three calcareous soils, amended or unamended with sewage sludge. Two first-order rate constants were used to describe both processes and to compare treatment effects of sludge addition, PCB concentration (5, 50, 500 mg/kg), soil textural class, and length of sludge incubation with soils prior to experimentation. Total loss of PCBs ranged from 8 to 33%. Fifty and 95% disappearance times range from 2.5 to 5.9 yr and 6.1 to 26.3 yr, respectively. Treatment effects on total loss closely paralleled those of volatilization. Volatilization of organics ranged from 5 to 31%, and was the major means of loss of ^{14}C in unamended soils and all 500 mg PCB/kg treatments. Volatilization, and thus environmental transport, was decreased by sludge addition. Exposure of the soil to sludge prior to experimentation had no effect on volatilization when compared to fresh sludge additions. Carbon-14-organic volatile loss was greater in two sandy loams than in a clay soil. Comparing PCB concentrations, volatilization was generally greatest at 50 mg/kg and least at 500 mg/kg, with comparatively smaller differences between 5 and 50 mg/kg. Degradation of ^{14}C-Aroclor 1254 to $^{14}CO_2$ ranged from 1 to 11%. Overall, $^{14}CO_2$ evolution, and thus detoxification increased with sewage sludge addition and decreased with increasing PCB concentration. Mineralization exceeded volatilization in sludge-amended soils at 5 mg PCBs/kg.

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REFER ALSO TO CITATION(S) 2935, 2971, 2972, 2973, 2975, 2978, 2979, 2980, 2993, 2997, 3017, 3046, 3047, 3048, 3049, 3050, 3051, 3052, 3057, 3058, 3059, 3060, 3061, 3062, 3063, 3064, 3065, 3066, 3068, 3069, 3072, 3077, 3084, 3087, 3124, 3125, 3126, 3127, 3130, 3131, 3132, 3133, 3134, 3135, 3136, 3138, 3139, 3140, 3142, 3143, 3144, 3145, 3146, 3147, 3148, 3149, 3150, 3152, 3157, 3159, 3457, 3458, 3459, 3460, 3461, 3462, 3717, 3919, 4119, 4188, 4261, 4327, 4328, 4333, 4334, 4417, 4419, 4423, 4517, 4525

4355 **(ANL-SSD/HP—86-102) Radiological assessment and remedial action report for the "Son of Lansdowne" property, 186 North Lansdowne Avenue, Lansdowne, Pennsylvania.** Smith, W.H.; Wynveen, R.A. (Argonne National Lab., IL (USA). Support Services Div.). Aug 1987. Contract W-31109-ENG-38. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88000197/JAW.

This document reports the results of a radiological assessment and remedial action program conducted by Argonne National Laboratory personnel at a radioactively contaminated private residence in Lansdowne, Pennsylvania. The program was conducted on the residence at 186 Lansdowne Avenue. The survey conducted by the ANL personnel indicated that several dozen areas or spots of contamination were present on all floors and the basement of the three-story house. Contamination was found on furniture, carpeting, walls, floors, woodwork, and ceilings. Remedial action undertaken to remove the contamination ranged from scrubbing, to scraping, to shaving of wood, to removal and disposal of items and material that could not be adequately decontaminated. Outdoors, contaminated soil was removed from the backyard, and the driveway was dug up so the contaminated subsurface material could be removed. The remedial action generated quantities of radioactive waste, including four 55-gallon drums and one M-III bin (120 ft^3) containing floor tile, concrete, personal items, furniture, floor scrapings, vermiculite absorbed scrub water, and other items. In addition, there were 24 M-III bins containing approximately 112 tons of contaminated soil and rock from the two contaminated areas in the backyard and from the contaminated subsurface of the driveway. 2 refs., 39 figs., 12 tabs.

4356 **(CEA-N—2517) Use of Tritium measurements for environmental monitoring.** Camus, H.; Carrere, D; Simeon, C. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). May 1987. 19p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750456/JAW.

Impact studies, compulsory for large installations and land use, require an environmental monitoring program throughout the plant operation. Therefore, and in appliance with the specific regulations concerning them, industrial plants of the nuclear fuel cycle must ensure environmental monitoring including measurements both on the air and water vectors and on the receiving compartments, i.e. food chains and consumers. The development of fine methods in order to assess the limiting capacity of the environment and evaluate the fate of the releases requires to have sensitive bioindicators. For radioactive releases, this is the case of tritium: following the fate of hydrogen, it combines with the vegetal or animal organic molecule, and therefore presents a biological half-life longer than in the elemental water on which measurements were carried out systematically up to now. The interest of measuring organically bound tritium in food chains is presented, and the corresponding technique is described.

4357 **(CONF-841142—, pp 1-25) Plutonium interactions with soil microbial metabolites: effect on plutonium sorption by soil.** Wildung, R.E.; Garland, T.R.; Rogers, J.E. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

To develop an understanding of the mechanisms of plutonium (Pu) complexation and solubilization by soil microorganisms, a broad range of bacteria and fungi were isolated in pure cultures from soil on the basis of metal tolerance and carbon requirements. The organisms were then used in investigations to examine Pu cel-

lular transport, Pu complexation by extracellular metabolites, and the effects of complexation on Pu valence state, chemical form, and solubility in soil. Of the 239 bacteria and 250 fungi isolated from soil, 19 bacteria and 60 fungi were selected for detailed study. Of these organisms, 15 bacteria and 18 fungi grew to form extracellular Pu complexes that increased the concentration of Pu in soil column eluates relative to controls. Elution through soil effectively removed positively charged Pu complexes. Increased Pu mobility in soil resulted from the formation of neutral and negatively charged Pu complexes, which differed with organism type. In the presence of known microbial metabolites and synthetic ligands (DTPA, EDTA, EDDHA), Pu(VI) was reduced to Pu(IV) before complexation, suggesting that Pu(IV) would be the dominant valence state associated with organic complexes in soils. Studies on selected organisms indicated that both active Pu transport and Pu sorption on the cell occurred, and these phenomena, as well as complexation by extracellular metabolites of Pu, were a function of the form of Pu supplied, the organism type and growth characteristics, and the ability of the organism to alter extracellular pH. 18 references, 6 figures, 7 tables.

4358 (CONF-841142—, pp 109-119) **Field studies on the terrestrial behavior of actinide elements in East Tennessee.** Garten, C.T. Jr.; Bondietti, E.A.; Trabalka, J.R.; Walker, R.L.; Scott, T.G. (Oak Ridge National Lab., TN). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

This chapter summarizes field studies on the comparative uptake of various actinide elements (^{232}Th, ^{233}U, ^{238}U, ^{239}Pu, ^{241}Am, and ^{244}Cm) by plants and animals inhabiting historically contaminated environments on the Oak Ridge National Laboratory (ORNL) reservation in East Tennessee. The present-day pattern of actinide element bioaccumulation by biota from a flood-plain site contaminated with Pu in 1944 is U > Th ~ Pu. Thus, the environmentally dispersed ^{239}Pu exhibits a transfer from flood plain soil to biota comparable to that of indigenous ^{232}Th and less than that of the indigenous ^{238}U. This biological ranking agrees with the chemical extractability of U, Th, and Pu from soil, using either weak acids or strongly basic reagents. The pattern of actinide element uptake by biota from the shoreline of a historically contaminated pond is Pu < Am ~ Cm < ^{233}U = ^{238}U. This biological ranking also agrees with the chemical extractability of Pu, Am, Cm, and U from shoreline sediment, using weak acids. There are apparent strong similarities in soil sorption, plant uptake, and animal uptake between trivalent Am and Cm and between tetravalent Pu and Th because they share the same valence state. Available evidence suggests that knowledge of the behavior of naturally occurring ^{232}Th in the terrestrial food chain can be useful for predicting the long-term fate of environmentally dispersed ^{239}Pu, whereas data on ^{238}U might be used to place an upper limit on the expected long-term food chain transfer of all transuranic elements except Np. 33 references, 5 figures, 1 table.

4359 (CONF-841142—, pp 121-130) **Plutonium in the desert environment of the Nevada Test Site and the Tonopah Test Range.** Romney, E.M.; Essington, E.H.; Fowler, E.B.; Tamura, T.; Gilbert, R.O. (Univ. of California, Los Angeles). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Several safety shot tests were conducted in the desert environment of the Nevada Test Site and the Tonopah Test Range during the period 1955 to 1963. Follow-up studies were conducted in fallout areas resulting from these tests to investigate the distribution in soils and the availability to animals and plants of plutonium (and americium) after residence times of 10 to 20 years. Soil profile studies disclosed that more than 95% of the plutonium (and americium) dispersed as fallout to the environment had remained in the top 5 cm of soil in undisturbed areas. Significant amounts had been redistributed into blow-sand mounds formed underneath clumps of vegetation. That redistribution should be expected because the contaminant was associated primarily with the coarse silt and fine sand particle size fractions. Resuspension factors were calculated that varied from 9.1 x 10^{-11} m^{-1} to 5.4 x 10^{-9} m^{-1} with geometric mean and arithmetic averages of 2.9 x 10^{-10} m^{-1} and 6.8 x 10^{-10} m^{-1}, respectively; however, the plutonium essentially remained in place when the soil surface was left undisturbed. Vegetation in the fallout areas was contaminated primarily by resuspendable material deposited on the surface of plant foliage; plutonium concentration ratios ranged from 10^{-3} to 10^{0}. Carcass samples of small vertebrate animals collected from fallout areas contained only trace amounts of plutonium compared to the environmental exposure levels. Furthermore, only trace amounts of plutonium (and americium) were found in muscle and organ tissues of grazing cattle during a 3-year on-site residence experiment. 36 references, 4 figures.

4360 (CONF-841142—, pp 131-146) **Radium, thorium, and the light rare earth elements in soils and vegetables grown in an area of high natural radioactivity.** Linsalata, P.; Franca, E.P.; Sachett, I.; Castro, M.B.; Lobao, N.; Ballad, R.; Lei, W.; Ford, H.; Morse, R.S.; Eisenbud, M. (New York Univ. Medical Center, New York). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

A study is in progress in Brazil to assess the soil-to-plant concentration ratios (CR) of the naturally occurring radionuclides ^{226}Ra, ^{228}Ra, ^{232}Th, ^{230}Th, and ^{228}Th and the light rare earth elements (REE) La, Ce, and Nd. Thorium serves as an analog for Pu(IV) and La or Nd as analogs for Am and Cm(III). A near-surface deposit of Th (~30,000 tons) and REE (>100,000 tons) exists at the center of the plateau near the summit of a small hill. No trends have been observed between farm soil concentrations and proximity to the ore body, substantiating earlier conclusions of the relative immobility of these elements from the deposit. New analytical procedures are presented for the sequential determination of isotopic thorium and the light REE in large biological samples. Typical radiochemical yields are 50 to 70% for Th and 80 to 100% for the REE. Preliminary analyses of seven vegetable types indicate that concentrations of Th, La, Nd, Ce, and Sm are quite variable between and among species. Average concentrations in plant tissues generally reflect soil abundances as: Ce > La > Nd > Sm ~ Th. Mean CRs are 604, 270, 24, 17, 8 and 1 for ^{228}Ra, ^{226}Ra, La, Nd, Ce, and Th, respectively. Plant uptake of elements with stable oxidation states of II, III, and IV decreases as Ra(II) > REE(III) > Th(IV), which may reflect the availability of these elements in soil. 33 references, 4 figures, 4 tables.

4361 (CONF-841142—, pp 147-156) **Density, movement, and transuranic tissue inventory of small mammals at a liquid-radioactive waste disposal area.** Halford, D.K. (Dept. of Energy, Idaho Falls, ID). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Linear movement, density, and transuranic radionuclide inventory were estimated for small mammals residing at a liquid radioactive waste disposal area in southeastern Idaho. Deer mice (Peromyscus maniculatus), kangaroo rats (Dipodomys ordii), western harvest mice (Reithrodontomys megalotis), and Great Basin pocket mice (Perognathus parvus) were the predominant species. The total small mammal population within the 3.0-ha waste area was estimated to be 93. The distance between consecutive captures for all species combined averaged 41 m and ranged from 7 to 201 m. About 30% of the rodents captured inside the waste area were also captured outside its boundaries. The total population inventory of ^{238}Pu, /sup 239,240/Pu, ^{241}Am, ^{243}Cm, and ^{244}Cm was 44 pCi, 30 pCi, 19 pCi, 21 pCi, and <1 pCi, respectively. One-third, or about 35 pCi of transuranics, could be removed from the waste area by small mammals during the summer of 1981. 16 references, 3 figures, 3 tables.

4362 (CONF-841142—, pp 225-253) **Erosional losses of fallout plutonium.** Foster, G.R.; Hakonson, T.E. (Los Alamos National Lab., NM). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Plutonium from fallout after atmospheric explosion of nuclear weapons in the 1950's and 1960s is being redistributed over the

landscape by soil erosion and carried on sediment by streams to oceans. Erosion rates computed with the Universal Soil Loss Equation for more than 200,000 sample points on nonfederal land across the US were used to estimate plutonium removal rates by soil erosion. On the average, only about 4% of the eroded sediment reaches the outlet of a major river. The remaining sediment is deposited en route, and because deposition is a selective process, the sediment is enriched in fine particles having the highest concentration of plutonium because of the element's strong association with clay and silt-sized sediment. Estimated enrichment ratios, sediment delivery ratios, and erosion rates were used to estimate annual delivery of fallout plutonium. These estimates ranged from 0.002% of the initial fallout plutonium inventory for the Savannah River basin to 0.01% for the Columbia River basin, to 0.02% for the Hudson and Rio Grande River basins, to 0.08% for the Mississippi River basin. If the deposition of plutonium had been uniformly 1 mCi/km^2, the estimated plutonium activity on suspended sediment would range from about 7 fCi/g of sediment of the Savannah River basin, to 9 fCi/g for the Mississippi River basin, to 12 fCi/g for the Hudson River basin, to 14 fCi/g for the Columbia and Rio Grande River basins. 45 references, 2 figures, 17 tables.

4363 (CONF-841142—, pp 429-433) **Summary of recent research on the environmental behavior of actinide elements.** Watters, R.L. (Dept. of Energy, Washington, DC). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

In a synthesis of the research literature on actinide elements through 1978, Watters et al. concluded that further research was required in three main areas. First, additional effort was required on the development of process-oriented dose models to serve as a framework for identifying mechanisms and processes for which data were lacking. Second, research was required on the environmental behavior of the transuranic elements neptunium, americium, and curium. Third, research was required on the factors controlling the oxidation/reduction of Pu(IV) to Pu(V) and Pu(VI), because there was evidence to suggest that this oxidation was occurring in some environmental systems and was resulting in increased solubility and mobility of Pu isotopes. In the 5 years that passed from the time of the Watters et al. summary researchers explored these areas. These studies resulted in numerous publications reported in this volume or published in journals or reports. In some cases, the research passed beyond the initially proposed areas. In this paper, the authors summarizes these recent achievements and offer suggestions for further areas where research is needed to expand their understanding of the environmental behavior of actinide elements.

4364 (EUR—10788(v.2)) **Study of long-term (10/sup 3/ - 10/sup 4/ YR) elemental migration in saturated clays and sediments.** Mac Kenzie, A.B.; Scott, R.D.; Ridgway, I.M.; Mc Kinley, I.G.; Hooker, P.J.; West, J.M. (SURRC, Glagow, UK; EIR, Wuerenlingen, Switzerland; BGS, Keyworth, UK). (Commission of the European Communities, Luxembourg). 1986. 85p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750662/JAW.

This report presents the results of a project to investigate the use of elemental profiles in Scottisch sediments resulting from the Flandrian marine transgression as a natural analogue of radionuclide migration through argillaceous material. The work was carried out within Research Area no. 5 of the CEC project MIRAGE (Natural Geological Migration Systems).

4365 (IAEA-RL—147) **Determination of radionuclides in grass ecosystem samples. Report of the consultants' meeting, Vienna, 23-25 September 1986.** LaBrecque, J.J.; Schelenz, R.; Perkins, R.W. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). Jul 1987. 76p. (CONF-8609348—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW.

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

The radioactive debris cloud from the Chernobyl reactor accident resulted in some deposition over essentially all of the Northern Hemisphere. Shortly after the accident invitations were sent out by the IAEA to Member States to collect grass samples according to specific instructions so that the ratio of the various radionuclides in the fallout debris could be established over a wide area of Europe. In response to this request, 20 grass samples were provided by Member States. To establish a protocol for analysis of these valuable samples and to recommend a protocol for future sample collection, a Consultants Meeting was called by the IAEA for 23-25 September 1986. This document contains the considerations and recommendations of the consultants. Figs and tabs.

4366 (IAEA-RL—147, pp 47-51) **Identification and assay of radionuclides in the environmental samples following Chernobyl reactor accident.** Prakash, S. (Bhabha Atomic Research Centre, Bombay, India. Radiochemistry Div.). Jul 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW. (CONF-8609348—).

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

In India radioactivity was detected from 2 May 1986 onwards. A variety of samples were assayed for radionuclides in the environmental samples originating from the Chernobyl reactor accident. These are: Cotton swipe samples from aircrafts, air filters, milk, goat thyroids, grass, vegetables and tap waters. The results are presented in the paper. 7 tabs.

4367 (IAEA-RL—147, pp 52-56) **Information on radiological situation and activities in Poland after the Chernobyl accident.** Rzymkowski, T. (Central Lab. for Radiological Protection, Warsaw, Poland). Jul 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW. (CONF-8609348—).

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

The basic objective of this paper is to present an overview of the radiological situation in Poland and the prophylactical and protection actions performed by the government.

4368 (IAEA-RL—147, pp 57-69) **Analyses of grass samples in Sweden after the Chernobyl accident.** Tovedal, H. (Studsvik Energiteknik AB, Nykoeping, Sweden). Jul 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW. (CONF-8609348—).

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

The radioactive fallout in Sweden was concentrated to the mid-eastern part of the country. A systematic survey of the country from south to north was done. Grass samples were taken at positions with relative distances of 20-50 km. In some areas in the north where there was very little grass, soil samples were taken. The results indicate that about 15-20% of the total fallout of Cs-137 will be found in the grass. Sr-90 analyses of grass samples show that the Sr-90/Cs-137 relation varies very little in the fallout over the country. The Sr-90 activity is everywhere between 1 and 3% of the Cs-137 activity. 6 figs.

4369 (IAEA-RL—147, pp 70-76) **Post-accident radiological measurements. Data from the Agency's laboratory in Austria.** Schelenz, R.; Abdel-Rassoul, A. (International Atomic Energy Agency, Seibersdorf, Austria. Laboratories). Jul 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700361/JAW. (CONF-8609348—).

From Consultants' meeting on the determination of radionuclides in grass ecosystem samples; Vienna, Austria (23 Sep 1986).

Early on 29th April 1986 the Chemistry Unit initiated some measurements of environmental radioactivity. The radioactivity was measured in air, grass, soil, rain water and fruits. The measurements which are presented here were carried out over the period 29 April-30 May 1986. Figs and tabs. Detailed report published in Int. At. Energy Agency Bull. (Aut 1986) Vol. 28(3) p. 23-26.

4370 (INIS-mf—10728) **2nd animal experiment to determine radioactivity in milk and meat (winter feed).** (Staatliche Lehr- und Versuchsanstalt fuer Viehhaltung, Aulendorf (Germany, F.R.); Konstanz Univ. (Germany, F.R.). Fakultaet fuer Physik). 1986. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750018/JAW.

Staatliche Lehr- und Versuchsanstalt fuer Viehhaltung Aulendorf. Bericht.; No. 3/1986.

High levels of the cesium isotopes 137 and 134, which were released by the Chernobyl reactor accident, are above all present in southern Germany in feeds for the winter of 1986/87. There are two possible pathways of how the fodder was contaminated: by deposition of radioactive material on the exposed parts of the plant and by uptake of radioactive material from the soil via the roots. The following questions were to be elucidated by the experiment: 1. Appraisal of the probable radioactive contamination of milk and meat, given the exclusive use of stored fodder from the first growth; 2. Determination of transfer factors and transfer rates for milk and meat; 3. Determination of the variation range for animal reactions to the use of contaminated fodder; 4. Drawing up of recommendations for feeding. For this purpose, eight cows were divided into two groups. One group fed on hay from the first growth as a sole basic feed, the other on silage fodder consisting of a mixture of hay and grass from the first growth (mixing ratio 40 to 60). The animals were fed individually, the feed being offered twice a day. The following parameters were recorded: quantity of milk (daily in kilogrammes), quantity of cesium in milk (every second day, Bq/kilogramme), silage grass fodder (10 samples, Bq/kilogramme), hay (10 samples and one control each week during the experiment, Bq/kilogramme), meat (from one cow out of each group, Bq/kilogramme).

4371 (INIS-mf—10730, pp 27-39) **Conversion of HT to HTO and OBT in the soil.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The temporal course of HT and HTO concentrations in the surface layer and of the changes in the HTO soil profiles within the dispersion sector are expected to supply the most significant information on tritium pathways in conjunction with HT release. Meteorological and soil-physical parameters are additionally determined to study basic correlations. Studies showed the re-emission rate to be determined by the gradient of HTO vapour partial pressure at the boundary surface between soil and atmosphere. These studies allow to describe the dynamics of HTO/HT/OBT transport in the environment.

4372 (INIS-mf—10730, pp 41-43) **Determination of Sr-90 and Cs-137 in environmental samples.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The comparison between the Ca concentration in the soil and the transfer factors involved indicates a clear dependence of Sr-90 soil-to-plant transport from the soil's Ca-content with the concentration level of 0.1 g Ca/kg soil appearing to be the limit level. Soil concentrations of Cs-137 determined to-date indicate a very even deposition density of Cs-137. The transfer factors of plant/soil in Chile differ but negligeably from those in Europe.

4373 (INIS-mf—10730, pp 63-70) **Investigations into the impact of soil parameters on radio-iodine migration in the soil.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

Water content, incubation temperature and organic soil components play a major part in iodine fixation. These variables also act as growth factors which regulate the activity of soil organisms thus suggesting the participation of biomass in the fixation process. The experiments were performed with I-125 using podzolic brown soil and chernozem.

4374 (INIS-mf—10730, pp 71-87) **Determination of uranium in environmental samples.** 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750171/JAW.

In 1986 annual report of the Lower Saxony Institute for Radio-Ecology at the Hanover University.

The research project was aimed at determining the concentration factors of uranium migrating from the soil to the plant for the territory of the FRG. To this end, the uranium contents of soils and crops were determined. The results achieved provide a survey on the uranium contents of farmed soils in the FRG in addition. A further focal point was the examination of the chemical behaviour of uranium in the soil in terms of its availability to plants. In addition, analyses were performed on a number of uranium samples from abroad.

4375 (INIS-mf—11045, pp 983-999) **Environmental isotopes assist in the site assessment of Vaalputs radioactive waste disposal facility.** Verhagen, B.T.; Levin, M. (Wits-CSIR Schonland Research Centre for Nuclear Sciences, University of the Witwatersrand, Johannesburg, South Africa; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The first South African nuclear waste disposal facility is to be sited in an arid environment with an average annual rainfall of about 78mm. The ground water might therefore be virtually stationary, making the geohydrology of the area crucial in the assessment of radionuclide dispersal difficult to study with standard hydraulic methods. Environmental isotopes, which label the water itself and some of its dissolved constituents are able to give synoptic information about the ground water; from this, some projections about future mobility can be made. Tritium profiles in the unsaturated zone show the limited extent of rain water infiltration, which generally extends down to 3-4 metres, with sporadic evidence of deeper penetration through cracks and rootholes in the thick clay cover. Soil moisture therefore seems to occur in tightly bound and more mobile components. This is confirmed by occasionally measurable tritium observed in the saturated zone. Radiocarbon in the ground water cannot be simply interpreted on account of the nature of the granite aquifer. Although suggesting ages of several thousands of years, radiocarbon proves that the water is not 'fossil' or derived from the last pluvial period, postulated to have occurred some 12,000 years ago. Recharge appears to be more ongoing and to occur periodically and locally as a result of outliers within the present climatological regime. Regional movement of ground water is however very limited, as spatial variations seen in the radiocarbon data of the ground water are non-systematic. These conclusions are supported by the distribution of the non-radioactive isotopes, such as oxygen-18.

4376 (NEI-DK—39, pp 44) **Tc-99 - a waste problem?.** Aarkrog, A. (Risoe National Laboratory, Roskilde, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4377 **(PTB-SE—14) Chemistry and migration behaviour of the actinides and fission products in natural aquatic systems. Proceedings.** Kim, J.I.; Warnecke, E. (eds.). (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Oct 1986. 341p. (In English and German). (CONF-8604362—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW.

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The 66th PTB seminar was held on April 24th and 25th, 1986, at the Munich Technical University (TUM) in Garching in cooperation with the Institute for Radiochemistry of the Munich

Technical University, the 'Nuclear Chemistry' special group of the Society of German Chemists, and UB/SN responsible for the BMFT project. The seminar was organized by the TUM's Institute for Radiochemistry. The seminar dealt with the following main topics: primary geochemical reactions and colloid formation; sorption mechamisms and migration behaviour in Konrad/Gorleben aquifer systems; sampling and experimental investigations; evaluation and interpretation of the data obtained by experiments. The seminar was to achieve the following objectives: information and exchange of experience with regard to the work carried out up to the present; if necessary, formulation of new issues to be discussed; improvement of the interdisciplinary cooperation (chemistry, geosciences, modelling). The following topics and individual aspects were of particular interest and were given special attention: complementary basic research in order to interpret, support and model the results obtained by experiments (sorption mechanisms and thermodynamic data for natural systems); comparability of batch, column and diffusion tests; transferability of laboratory data to natural systems (e.g. Gorleben, Konrad); redox transitions for Np, Tc at Eh values of the natural systems; dependence of the sorption/desorption data on different influencing factors, importance of the influencing factors and selection of data for model calculations. Subject analyses of the individual contributions have been made for the Energy data base.

4378 (PTB-SE—14, pp 90-99) **Uranium speciation in groundwater of the Gorleben site.** Koss, V. (Technische Univ. Berlin, Germany, F.R. Inst. fuer Kerntechnik). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The paper reports laboratory experiments on the adsorption of problematic radionuclides as an assessment of conditions at the planned Gorleben repository. Among the nuclides selected for the experiments, uranium is the only one that has been used in cationic form in the experimental solutions. The experimentally determined data concerning the composition of the groundwater, especially the amount of the anions that form complexes with the uranium, form part of the model calculations for uranium speciation using the MINEQL program. The program computes the correlation between sorption and speciation and yields the following information: (1) There is no sorption of anions in the sediments investigated. (2) A maximum of 1%. of cationic sorption is dependent on the complex formation as a function of groundwater composition. (3) In quartz sediments, the sorption coefficient can be assessed via the standard concentration of the uranium-silicato complex.

4379 (PTB-SE—14, pp 128-139) **Mechanisms of the sorption of radionuclides in the geosphere and the impacts of colloid formation and complex formation.** Lieser, K.H.; Gleitsmann, B.; Peschke, S. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

A general equation is presented describing the sorption process in natural systems, including sorption at external surfaces and in porous components of the solid phase (sediment), as well as monodirectional reactions. In a natural system comprising in addition to the sediment coarse-disperse and fine-disperse (colloidal) particulate matter, sorption equilibria occur that lead to a rise of experimentally observed sorption values with the ratio volume of the solution to amount of sediment, and this as a function of filtration conditions. Under certain conditions, complex formation in the solution also may create a dependency of this kind.

4380 (PTB-SE—14, pp 140-149) **Sorption, desorption, and exchange of cesium by quaternary glaciofluvial waste gravel soils and clay minerals.** Gruetter, A.; Gunten, H.R. von. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland; Bern Univ., Switzerland. Radiochemisches Lab.). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Isotherms of the sorption, desorption, and exchange of cesium-137 in the concentration range 10/sup -11/-10/sup -3/ m have been measured in synthetic groundwater (Ca, Mg, K, Na) with waste gravel material from the Swiss Mittelland, covering a wide range of grain size fractions (< 4 mm). The isotherms are strongly non-linear. After standardisation by means of the cation exchange capacity, all sorption isotherms are found to be within a relatively small range of values and allow a general statement to be made on the equilibrium behaviour of cesium in waste gravel soils of the Prealps. Desorption and exchange of cesium have been found to be strongly hampered by structural changes in clay minerals. The cesium isotherms measured for the gravel soils are compared with isotherms determined for the clay minerals montmorillonite, illite, and chlorite. The gravel soil isotherms are interpreted to be very much influenced by the presence of illites and chlorites.

4381 (PTB-SE—14, pp 150-161) **Sampling and specimen preparation of unconsolidated rock and solid rock for migration studies with radionuclides.** Bruehl, H.; Trapp, C.; Winkler, A. (Freie Univ. Berlin, Germany, F.R. Inst. fuer Angewandte Geologie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The various techniques are discussed of the sampling of rock or groundwater specimens from the geological environment of a repository for radioactive waste (Gorleben, Konrad shaft). The paper explains the sampling campaign made within the frame of the 'Hydrogeological drilling programme Gorleben (Gohy)' and summarizes the results and experience, leading to an outline of improvements that can be made in order to obtain better information on the radionuclide migration.

4382 (PTB-SE—14, pp 173-183) **Problems encountered with single-pass column experiments with cohesive material.** Klotz, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Radiohydrometrie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

There are three main problems to be solved in experiments with single-pass columns for determining sorption characteristics of radionuclides in cohesive material. In order to maintain the fabric of the cohesive material, the samples should be left as untouched as possible during packing, and the smallest retardation factors and dynamical distribution coefficients are given for authentic packing. When experiments are carried out over a longer period of time it is difficult to keep the flow constant with a given slope. In this case, too, flow fluctuations are kept small by authentic packing. Tritiated water can be used as a tracer for determining the hydrodynamical flow parameters (such as velocity and effective porosity) only after correcting the transport velocity of the tritiated water.

4383 (PTB-SE—14, pp 196-207) **Experimental determination of the migration behaviour of fission products in single-pass columns.** Trapp, C.; Bruehl, H.; Winkler, A. (Freie Univ. Berlin, Germany, F.R. Inst. fuer Angewandte Geologie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

In sands and cohesive rock from the Gorleben area and in solid rock from the Konrad shaft, the migration conditions of fission products, or the retention capacity of the samples for tritium, bromine-77, selenium-75, and technetium-95 m has been studied in a single-pass column system. The peripheral parts of the experimental system have carefully been chosen so as to ensure exclusion of atmospheric oxygen over the experimental period of several months. The experimentally obtained break-through curves for T show a delay as compared with Tc-95 m and Se-75, which makes it impossible in this case to determine the real distance velocity and thus the effective pore volume. For cohesive rock, equating overall porosity with effective porosity is not possible. Calculation of retardation factors and distribution coefficients therefore is made by equations putting the effective porosity to be 5, 10, or 15%, respectively.

4384 (PTB-SE—14, pp 208-217) **Evaluation of diffusion experiments: Comparison of two methods.** Wolfrum, C.; Lang, H.; Moser, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Radiohydrometrie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The diffusion experiments made in accordance with the examples given by Swedish experts or by Bradbury/Crank require the initial activity in the active feed reservoir to be constant over the entire experiment. As this condition frequently can be fulfilled only approximatively, the diffusion coefficients are calculated by means of Fick's second law, taking into account concentration changes in the two reservoirs. This evaluation method is explained for some experiments with solid rock samples from the natural environment of the Konrad ore mine, and is compared with the method applied by Bradbury/Crank.

4385 (PTB-SE—14, pp 218-227) **Determination of K/sub d/-values from diffusion experiments.** Meier, H.; Hecker, W.; Zimmerhackl, E.; Zeitler, G.; Menge, P. (Staatliches Forschungsinstitut fuer Geochemie, Bamberg, Germany, F.R.). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Results of diffusion measurements are reported, obtained with aqueous solutions of U-233, Ra-226, Ni-63, and Se-75 in contact with solid rock samples of the Konrad mine overlying rock. The subsequent derivation of K/sub d/-values and the method applied are explained.

4386 (PTB-SE—14, pp 228-243) **Technetium sorption by samples from the overlying rock of the Gorleben salt dome, under aerobic and anaerobic conditions.** Hanke, C.; Lieser, K.H. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The shaking experiments for determination of sorption data of technetium have been made with ten authentic samples of the unconsolidated rock and groundwaters from overlying rock of the Gorleben salt dome (well depths between 3 and 244 m). The sorption data have been taken after a period of seven days up to three months. As the sorption behaviour of Tc very much depends on the oxidation number, the experiments have been carried out under both aerobic and anaerobic conditions (the latter in an inert gas box, argon + 1% CO/sub 2/). Further, the effects of EDTA, N-alkylbenzyl sulphonic acid, pyrite, magnetite, CdS, and FeS have been examined. The pH-value and the V/m ratio have been varied. The R/sub S/-values for aerobic conditions have been measured to be between 0 and 0.40 ml/g. Extraction with tetraphenylarsonium chloride revealed TcO/sub 4//sup -/. Addition of FeS strongly augmented the R/sub S/-value. All other conditioning means showed no effect. Under anaerobic conditions, a reduction of Tc(VII) to Tc(IV) has been observed. R/sub S/-values of all samples have been > 100 ml/g. Addition of N-alkylbenzyl sulphonic acid reduced this value. Variation of pH and V/m ratio showed no effect.

4387 (PTB-SE—14, pp 244-256) **Dependence of radionuclide sorption on the concentration.** Lang, H.; Wolfrum, C.; Moser, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Radiohydrometrie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Experience gained in batch experiments with radionuclides in natural sediment-water mixtures has shown that only in a few exceptional cases the description of the sorption processes by a constant value R/sub S/ that is independent of the concentration is suitable. The experimental data rather show that there is a considerable effect of the initial radionuclide concentration and the given mass-to-volume ratio, and that there are differences observable between the sorption and desorption constants that have been determined. These dependencies are explained by a description of radionuclide sorption as a function of concentration, using for reasons of better applicability an isotherm between the given initial radionuclide concentration and the radionuclide equilibrium concentration in the solution. Using this isotherm in the chemical separation stage model allows predictions to be made about the radionuclide distributions created by concentration effects for the case of dynamical transport of radionuclides with the groundwater flow.

4388 (PTB-SE—14, pp 268-280) **Sorption of neptunium by unconsolidated rock from the overlying rock of the Gorleben salt dome under aerobic and anaerobic conditions.** Muehlenweg, U.; Lieser, K.H. (Technische Hochschule Darmstadt, Germany, F.R. Fachbereich 8 - Anorganische Chemie und Kernchemie im Edward-Zintl-Institut). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The sorption study with neptunium has been made in circulation columns packed with unconsolidated rock and groundwaters from the natural environment of the Gorleben salt dome. The groundwaters have been brought to equilibrium state by means of high-annealed NpO/sub 2/ and have then be fed under aerobic and anaerobic conditions into the circulation columns packed with natural samples of the unconsolidated rock. The columns and the experiments are described. In the anaerobic experiments the neptunium is present as Np(V). Equilibrium status has been obtained after 60 days. The measured sorption values R/sub S/ are between 1 and 20 ml/g, and the R/sub S/-value corresponds to the determined R/sub D/-value. In the anaerobic experiments in an inert gas box (99% argon + 1% CO/sub 2/ + 200-500 ppm O/sub 2/) neptunium has been present as Np(V) and Np(IV). With loose rock obtained from greater depths the R/sub S/-values are > 100 ml/g, and equilibrium status has not been reached after 60 days. After ultrafiltration of the groundwater in the presence of Np(IV) a clear decrease of concentration has been observed.

4389 (PTB-SE—14, pp 281-292) **Adsorption and desorption experiments in the natural redox milieu over several months, using technetium as an example.** Winkler, A.; Bruehl, H.; Trapp, C. (Freie Univ. Berlin, Germany, F.R. Inst. fuer Angewandte Geologie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Complicated experimental equipment has been developed in order to carry out long-term laboratory studies under true to reality, stable conditions simulating the natural milieu of the formation waters, i.e. the redox potential in the range + 200 to -70 mV. The single-pass column experiments have been made with loose rock samples from the Gorleben site and with natural formation water samples in order to study the adsorption and desorption and thus the mobility of technetium, as well as the building up of the geochemical equilibrium state, which has been studied in circulation columns. The results show that the process of Tc fixation in the loose rock in a lower redox milieu is not so much influenced by adsorption or desorption conditions but rather more by changes of the Eh-conditions, i.e. by the oxidation stage of the technetium.

4390 **(UCRL—53798) Bikini Atoll ionizing radiation survey, May 1985-May 1986.** Shingleton, K.L.; Cate, J.L.; Trent, M.G.; Robison, W.L. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1987. Contract W-7405-ENG-48. 85p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88001322/JAW.

Between 1946 and 1958, the United States conducted 23 nuclear tests at the Bikini Atoll in the Marshall Islands, which resulted in extensive radioactive contamination of a number of islands in the atoll and prevented the timely resettlement of the native population. Although the external dose rates from beta and gamma radiation have been previously determined by aerial survey and a variety of ground measurement techniques, technical constraints limited the assessment of external beta dose rates that result from the ^{137}Cs and $^{90}Sr/^{90}Y$ contamination on the islands. Now, because of the recent development of very thin thermoluminescent dosimeters (TLDs), the external beta dose rates can be measured. 18 refs., 7 figs., 5 tabs.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 2809, 3055, 3159, 3460, 4353

4391 **(EGG—10282-2168) Diet of the San Joaquin kit fox, Vulpes macrotis mutica, on Naval Petroleum Reserve No. 1, Kern County, California, 1980-1984.** Scrivner, J.H.; O'Farrell, T.P.; Kato, T.T.; Johnson, M.K. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Jun 1987. Contract AC08-83NV10282. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000747/JAW.

A total of 1430 scats of the San Joaquin kit fox, Vulpes macrotis mutica, were collected between 1980 and 1984 on Naval Petroleum Reserve No. 1, Kern County, California, and analyzed to determine frequency of occurrence of prey items. Lagomorphs (black-tailed jackrabbits and desert cotton-tails) were the primary prey species (frequency of occurrence = 73%); while kangaroo rats (Dipodomys spp.) were the next most common (13%). The proportions of lagomorphs and kangaroo rats in the diet did not differ between sexes of foxes, periods of the year, or topography. Intensity of petroleum developments had no observable influence on food habits. There were annual differences in diet: proportions of lagomorphs declined, and proportions of kangaroo rats increased between 1980-1984. Changes in the frequency of occurrence of lagomorphs were significantly correlated with changes in their relative abundance in undeveloped-flat habitat. The frequency of occurrence of kangaroo rats was not significantly correlated with their relative abundance. San Joaquin kit fox on NPR-1 fed primarily on lagomorphs, and had the ability to sustain themselves on kangaroo rats and other secondary prey when their primary prey declined.

4392 **(EGG—10282-2173) Distribution of the endangered giant kangaroo rat, Dipodomys ingens, on the Naval Petroleum Reserves, Kern County, California.** O'Farrell, T.P.; Mathews, N.E.; Kato, T.T.; McCue, P.M.; McManus, J.S.; Sauls, M.L. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Jul 1987. Contract AC08-83NV10282. 37p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88000986/JAW.

Field surveys were conducted to determine the distribution and relative abundance of burrow systems of the endangered giant kangaroo rat, Dipodomys ingens, on the US Department of Energy's Naval Petroleum Reserves (NPR-1, NPR-2) in Kern County, California. A total of 1080 burrow systems were observed on 30 sections of NPR-1, 22 sections of NPR-2, and six adjoining sections. Most burrow systems were found in clusters on deep sandy loams in Buena Vista Valley, but isolated burrows were found in similar soils on the upper slopes or crests of ridges in 30 other sections of the reserves. Burrow systems had an average of 3.3 horizontal entrances measuring 2.7 in. high and 3.4 in. wide, and an average of 1.4 vertical entrances 2.0 in. in diameter. In the valleys burrows occurred in a density of 28.2 per acre; had an average slope angle of 4.3°; were within 3.3 yd of a perennial shrub, usually a cheese-bush, Hymenoclea salsola; had a predominantly southern aspect; and were grazed by sheep, but were remote from petroleum production activities. In the uplands burrows occurred in a density of 0.1 per acre; had an average slope angle of 6.4°; were within 5.1 yd of a perennial shrub, usually a desert saltbush, Atriplex polycarpa; had no particular aspect; and were not grazed by sheep, but were close to petroleum production activities. Since 1980, preconstruction surveys have helped conserve giant kangaroo rat burrows that may have been inadvertently threatened by construction projects on the reserves.

5106 Regulations

REFER ALSO TO CITATION(S) 3053, 3167, 4069, 4513

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 4269

5201 Basic Studies

4393 **(CONF-8709141—1) An experimental approach to determining subsurface leakage from a surface impoundment using a radioisotope tracer.** Ashwood, T.L.; Story, J.D.; Larsen, I.L.; Schultz, F.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014784/JAW.

From International Atomic Energy Agency research coordination meeting; Oak Ridge, TN, USA (7 Sep 1987).

Bromine-82, a 35.3-h half-life radionuclide, was used as a tracer to determine the paths and rates of leakage from an unlined, 1,000,000-gal (3,785,000 L), surface impoundment at the Oak Ridge National Laboratory. Since the impoundment is underlain and surrounded by storm sewer and sanitary sewer lines (most of them predating the impoundment), known and suspected leak sites in storm drain catch basins and sanitary sewer manholes were sampled periodically and analyzed for ^{82}Br. A series of four ground water monitoring wells - three downgradient and one upgradient from the impoundment - were also sampled for ^{82}Br. Although the catch basin and manhole samples picked up ^{82}Br in leakage from the impoundment less than 5 h after application of the tracer, the monitoring well samples did not contain detectable levels of the radionuclide. It was concluded that the monitoring wells were sampling groundwater moving through the formation, whereas the storm drains and manholes were sampling water leading rapidly through secondary porosity and along preferred pathways. The decline in tracer concentration as a function of time was used to determine the residence time of water in the pond and hence the flow rate through the pond. This flow rate, when compared with the known

outflow rate, indicated that the leakage flow was small. Hence, the main value of the test was to identify rapid leakage pathways. The experiment demonstrates the need for sampling subsurface drain systems as part of an integrated monitoring system for leak detection. The effectiveness of ^{82}Br as a tracer for rapid leaks was also shown.

4394 **(NP—8750010) Stochastic models of the motion of suspended particles in a turbulent fluid.** Faerber, K. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen). 1987. 240p. (In German). NTIS (US Sales Only), PC A11. Order Number DE88750010/JAW.

A description of dispersion processes has been developed, which offers new possibilities to investigate dispersion of suspended particles in a turbulent fluid or to perform numerical simulations. In the experimental section of the work the model assumptions of the stochastic description of dispersion are checked. As a result the stochastic models have to be improved with respect to the used time scales if they should give realistic results.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2855, 3230, 3596, 3597, 3598, 3599, 3600, 3601, 3602, 3603, 3604, 3605, 3606, 3607, 3608, 3609, 3610, 3611, 3612, 3818, 4265, 4342, 4343, 4542

4395 **(AD-A—183482/9/XAB) Installation-restoration program. Phase 2. Confirmation/quantification. Stage 1 report for Beale AFB, Maryville, California. Volume 2. Final report, September 1985-May 1987.** Bauer, R. (AeroVironment, Inc., Monrovia, CA (USA)). May 1987. 726p. (AV-FR—86/517R2). NTIS, PC A99/MF E04.

The overall objective of the Phase II investigation is to define the magnitude, extent, direction, and rate of movement of identified contaminants in the ground water. A series of staged field investigations may be required to meet this objective. The contractor shall recommend any additional investigations required beyond this stage, including an estimate of costs. The purpose of this task is to undertake a field investigation at Beale AFB, Ca: (1) to determine the presence or absence of environmental contamination within the specified areas of investigation; (2) if contamination exists, to determine the potential for migration of these contaminants in the various environmental media; and (3) to identify potential environmental consequences and health risks of migrating pollutants based on applicable local, state and/or federal standards.

4396 **(AD-A—183675/8/XAB) Installation-restoration program. Phase 2. Confirmation/quantification. Stage 1 for Mather AFB, Sacramento, California. Volume 1. Final report, September 1983-June 1986.** (Weston (Roy F.), Inc., West Chester, PA (USA)). 15 Jun 1986. 140p. NTIS, PC A07/MF A01.

A Problem Confirmation Study was performed at three sites on Mather AFB identified in the Phase I investigation as requiring further study (the Air command and warning Area, the 7100 Area, the West Ditch) and the Northeast Perimeter. The field investigation was conducted from February 1984 to June 1985 and included installation of 11 monitor wells, collection of groundwater samples from the monitor wells and 15 base production wells, and collection of sediment samples from two locations on the West Ditch. Analytes included oil and grease, TOC, volatile organic compounds (VOA), as well as dimethylnitrosamine, phenols, pesticides, and dissolved metals at some specific sites. Based on the hydrogeologic complexity of the physical setting and the findings of the sampling and analytical work, follow-on investigations were recommended at all three sites.

4397 **(AD-A—183743/4/XAB) Evaluation of grease-management alternatives for Army wastewater collection and treatment systems. Final report.** Bandy, J.T.; Marlatt, R.M.; Lang, L.E.; Poon, C.P.; Skov, K. (Army Construction Engineering Research Lab., Champaign, IL (USA)). May 1987. 48p. (CERL-N—87/15). NTIS, PC A03/MF A01.

Research was conducted to: determine the nature and extent of grease and oil problems at fixed Army installations, identify the installations' current oil- and grease-control practices, and evaluate these methods' effectiveness and cost, identify, from published information, commercially available grease- and oil-control methods (including chemical and biological additives) and establish their properties and applications, collect and evaluate case histories, and provide guidance for determining whether use of an alternative method would be cost-effective at military installations. A survey determined that over two-thirds of the installations responding experienced problems with grease and oil accumulation. Over 80% had problems at least monthly. Army-wide, thousands of dollars are spent each year on grease management. Mechanical-cleaning methods are labor-intensive and provide only a short-term solution; chemical cleaners are expensive and can be dangerous to treatment-plant workers and the environment. Commercially available biological additives for grease and oil control are identified and described. In addition, case histories are evaluated. Results indicate that the decision to use biological additives in controlling oil and grease accumulation should be made on a case-by-case basis. A procedure is proposed for helping installations calculate grease management costs and determine if use of an alternative technology would be cost-effective.

4398 (CONF-841142—, pp 193-233) **Watershed erosion and sediment yield affecting contaminant transport.** Lane, L.J.; Hakonson, T.E.; Foster, G.R. (Dept. of Agriculture-ARS, Tucson, AZ). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Relationships between sediment-associated contaminants and erosion and sedimentation processes are described, and some gaps in knowledge (with respect to erosion and sediment yield modeling) for improved understanding of contaminant transport and redistribution are identified. Watershed processes and erosion and sediment yield models are discussed. Two upland erosion models are described in detail, and criteria for application of more complex watershed models are identified and explain using example applications. New applications in modeling erosion and sediment yield are outlined, and the concept of an embedded and complex computer simulation model in an expert system is introduced. 55 references, 1 figure, 4 tables.

4399 **(GAO/RCED—87-60BR) Hazardous waste: Enforcement of certification requirements for land disposal facilities.** (General Accounting Office, Washington, DC (USA)). 1987. 66p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Environmental Protection Agency does not close all certifying facilities that are considered to be out of compliance with groundwater monitoring and/or financial responsibility requirements at the time of certification. This may be in the case where technical complexities make it difficult to prove that a violation exists; where the violation was minor; and where facilities were erroneously told by EPA or a state that they were in compliance with the regulatory requirements prior to their certification. In such cases, EPA's policy is to take enforcement action against facilities to achieve regulatory compliance rather than force them to close. EPA also targets noncertifying facilities for priority inspection when it suspects that they are operating illegally - after Nov. 1985. EPA's actual closure progress is far behind its regulatory timetable. And while the facilities await closure, they represent a potential environmental hazard and require monitoring to ensure they are complying with applicable regulations.

4400 **(GKSS—87/E/18) Spreading of hazardous substances in the southern German Bay and the Elbe-estuary after discharge from ships. An ecological risk assessment by numerical model calculations.** Duwe, K.C.; Krohn, J.; Pfeiffer, K.D.; Riedel-Lorje, J.C.; Soetje, K.C. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik; Deutsches Hydrographisches Inst. (DHI), Hamburg (Germany, F.R.)). 1987. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750006/JAW.

Based on realistic assumptions about accidents of ships carrying dangerous goods, the spreading of released substances is estimated with numerical models and the ecological consequences are investigated. Three locations have been chosen that constitute different biotopes and are distinguished by frequent shipping. The spreading of substances is simulated by a tracer method that is based on the results of three-dimensional baroclinic and barotropic North Sea and estuary models.

4401 **(NP—8770011) Heavy metals in river sediments (Regnitz, Central Franconia) as a function of sediment parameters.** Heravi, F. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Fachbereich Naturwissenschaft). 16 Jul 1984. 152p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770011/JAW.

The following subjects are discussed: The pollutant concentrations in sediments of the Regnitz river, the Dechsendorf lake, and high water sediments, the time variation of the heavy metal concentrations in the regions of investigation, the local heavy metal distribution as a function of the depth and width of the river bed, the applicability of common standards as 'natural background' and the effects of grain size and organic substances on the heavy metal concentrations in the sediments. The heavy metal concentrations in the Regnitz sediments are high (Cd, Pb, Cu).

4402 **(NP—8770020) Gassing of biosuspensions in bubble column and loop reactors.** Mueller, G. (Stuttgart Univ. (Germany, F.R.). Fakultaet 13 - Verfahrenstechnik). 14 Apr 1986. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770020/JAW.

In the aereation tanks of biological waste water purification plants, oxygen is consumed in the aerobic metabolism of microorganisms. As a rule, oxygen is supplied by gassing the sludge/water suspension with air. The parameters determining the gas/liquid transport, i.e. the void gas velocity, bubble size and bubble distribution, were determined using the specific mass transfer coefficient k/ sub L/ a/w/sub G/. The coefficient is determined, for the most part, by the aereator characteristics and by the coalescence behaviour of the water/sludge suspension. The influence of these parameters on the optimum reactor height under energy aspects is shown using mathematical models. The findings suggest that the optimum reactor height is not constant but depends on the aereator parameters, the water coalescence characteristics, and the remixing of the liquid phase.

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REFER ALSO TO CITATION(S) 2978, 2993, 2997, 3015, 3016, 3017, 3023, 3062, 3064, 3066, 3082, 3083, 3133, 3138, 3145, 3150, 3151, 3160, 3917, 4265, 4333, 4334, 4362, 4363, 4377, 4387, 4568

4403 **(AERE-R—12685) Study of fish and shellfish radioactivity levels in Cumbrian near-shore waters, November 1984-December 1986.** McKay, W.A.; Szweda, C. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jul 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750649/JAW.

Fish (cod, plaice, whiting and skate), crustacea (shrimp, Nephrops, crab and lobster) and mollusc (winkle) samples were collected from Cumbrian near-shore waters between November 1984 and the end of December 1986. The samples were analysed for total beta activity and a range of gamma and alpha emitters. In general the radionuclide levels were lower in 1986 than in 1985. On the assumption of constant consumption rates, the intakes of all consumers have decreased. In particular, the doses incurred by the critical group of local seafood consumers near Sellafield, mainly due to winkle consumption, were below the ICRP dose limit for the public of 1 mSv $year^{-1}$.

4404 (CONF-841142—, pp 27-48) **Chemical speciation of plutonium in natural waters.** Nelson, D.M.; Larsen, R.P.; Penrose, W.R. (Argonne National Lab., IL). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The behavior of plutonium (Pu) in natural waters is determined to a major degree by which chemical forms of the element are present. The authors have used a combination of field measurements and laboratory experiments to characterize the ambient Pu in a number of surface waters with regard to its oxidation state and association with natural colloidal organic carbon compounds. Both of these factors are shown to have a profound effect on the adsorption of Pu to natural sediments, with both complexation with organic matter and oxidation decreasing adsorption. The concentration of organic carbon in the water is the key variable influencing both oxidation state and organic binding of Pu. The adsorption process conforms to the laws applicable to a reversible equilibrium, with values of the distribution coefficient, K/sub d/, measured in laboratory experiments being similar to those observed for ambient Pu. Experiments using natural waters and sediments in which the Pu concentration was varied show that the forms present at typical ambient concentrations (10^{-17} to 10^{-14} M) are the same as those found at concentrations up to 10^{-7} M. Moreover, the affinity of Pu for sediments did not change with concentration, indicating that the binding sites for Pu had not become saturated. Thus, the behavior observed for Pu at ultratrace concentrations should remain unchanged throughout this concentration range. The studies reported here all deal with Pu in exchangeable forms and should, therefore, reflect the behavior pattern that Pu from any source will follow with time. 15 references, 7 figures, 10 tables.

4405 (CONF-841142—, pp 49-72) **Laboratory studies of actinides in marine systems.** Choppin, G.R.; Morse, J.W. (Florida State Univ., Tallahassee). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The stability of Pu(VI) and Pu(V) has been studied in 0.7M and in seawater solutions. In the absence of organic reductants, Pu(V) was found to be the stable state. Humic materials, however, cause a slow reduction to Pu(IV). Model calculations using measured reduction potentials, stability constants, etc., indicate that Pu(V) should be the stable state if the Eh of seawater to plutonium reduction is 0.5 to 0.7 V, which is the range of reduction potential of humic materials. Sorption studies on carbonates and oxides show rapid, strong uptake of actinides in the III, IV, and V oxidation states. The rate of sorption is proportional to the actinide concentration, the solution-to-solid ratio, and the surface area of the solid. There was evidence for irreversibility in the sorption. In general, sorption on the carbonates was faster and more than on oxides per unit surface area. In the absence of organics, no reduction of Pu(V) was observed following sorption on carbonates. Preliminary data, however, indicate Pu(V) may be reduced on iron oxides to Pu(IV), subsequent to adsorption. 50 references, 10 figures, 10 tables.

4406 (CONF-841142—, pp 255-271) **Transuranic radionuclides in the Columbia River: sources, inventories, and geochemical behavior.** Beasley, T.M. (Argonne National Lab., IL). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW. Contract AT06-77EV70030.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The sources, inventories, and geochemical behavior of transuranic and other long-lived radionuclides in the lower Columbia River are summarized. Inventories have been estimated from the measured activities of the different radionuclides in 50 cores raised in 1977 and 1978, while annual export of transuranic radionuclides was determined from monthly water collections in the estuary. Continental shelf inventories of Pu and Am isotopes have been estimated using excess ^{210}Pb inventories and the mean ^{210}Pb//sup 239,240/Pu inventory ratio of 100 +/- 19 observed in representative cores raised from the shelf. Despite the substantial past addition of radioactivity to the river from operation of the plutonium production reactors at Hanford, the amounts of reactor-derived radionuclides in river sediments are small relative to fallout-derived nuclides. Erosional processes have mobilized both fallout-derived / sup 239,240/Pu and ^{137}Cs from the landscape to the river, but the quantities involved represent <1% of their fallout inventories within the river's drainage basin. 36 references, 6 figures, 2 tables.

4407 (CONF-841142—, pp 273-297) **Transport of fallout and reactor radionuclides in the drainage basin of the Hudson River estuary.** Simpson, H.J.; Linsalata, P.; Olsen, C.R.; Cohen, N.; Trier, R.M. (Columbia Univ., Palisades, NY). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Fallout plutonium and radiocesium derived from both weapons testing and local reactor releases are found in the water column and sediments of the Hudson River in readily measurable amounts. The history of fallout delivery and dissolved phase runoff from the drainage basin of ^{90}Sr, ^{137}Cs, and /sup 239,240/Pu have been extensively documented since the mid-1950s. Sediment and water column concentrations of ^{134}Cs, ^{137}Cs, and /sup 239,240/Pu in the Hudson have also been documented since the mid-1960's and are summarized. Since the peak fallout years, substantial portions of the fallout radionuclides in the drainage basin have become unavailable to normal weathering processes as reflected by a measured decrease in the fallout nuclide transport to the waters of the tidal Hudson. Budget calculations indicate that plutonium may be transported into the estuary from the coastal ocean, and that desorption of radiocesium from particles has allowed a substantial fraction of radiocesium to be exported from the Hudson to marine waters. 29 references, 6 figures, 8 tables.

4408 (CONF-841142—, pp 299-317) **Transport of plutonium by the Mississippi River system and other rivers in the southern United States.** Scott, M.R.; Salter, P.F. (Texas A & M Univ., College Station). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The distribution of fallout Pu has been studied in the sediments and water of the Mississippi River and eight other rivers. Plutonium content of the sediments is related to grain size and Fe and Mn content. Rivers in human climates show relatively high organic carbon (3 to 4%) and high /sup 239,240)Pu content (36 to 131 dpm/kg) in their suspended sediments. Dissolved Pu is very low in all the rivers; distribution coefficients vary from 10^4 to 10^5. The ^{238}Pu//sup 239,240/Pu ratios are low in all the river sediments (~.06) except the Miami River in Ohio, where ratios as high as 99 were measured. The high ratios originate from the Mound Laboratory Pu processing plant at Miamisburg, Ohio, and can be traced downstream to the junction with the Ohio River. Mississippi River suspended sediment shows a continual decrease of /sup 239,240/Pu content over a 7 year time period. An exponential curve best-fit through the data predicts a half time of decrease equal to 4.3 years. The decrease in Pu content of river sediment results from several factors: cessation of atmospheric weapons testing; transport of Pu to deeper levels of soil profiles; storage of sediment in flood plains and behind dams; and dilution by erosion by older, prebomb soil material. The amount of fallout Pu now removed from the Mississippi River drainage basin to the ocean is 11% as a maximum estimate. Most the fallout Pu in the Mississippi drainage basin will remain on the continent unless there are major changes in erosion and sediment transport patterns in the basin itself. 56 references, 7 figures, 2 tables.

4409 (CONF-841142—, pp 319-340) **Comparative behavior and distribution of transuranium nuclides in selected components of test reactor leaching ponds.** Kuzo, G.B.; Fraley, L. Jr.; Whicker, F.W.; Markham, O.D. (Colorado State Univ., Fort Collins). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The distribution and kinetics of ^{238}Pu, /sup 239,240/Pu, ^{241}Am, ^{243}Cm were studied in abiotic and biotic components of test reactor leaching ponds located on the Idaho National Engineering Laboratory from June through July 1979. Highest transuranium concentrations (Bq/g [nCi/g] range) were recorded for seston and periphyton with lowest concentration ($\mu Bq/cm^3$ [fCi/cm^3] range) for filtered water. Concentration ratios for each nuclide differed among components with highest values recorded for seston and periphyton matrices (10^4 to 10^5) and lowest values for sediments (10^2 to 10^3). Concentration ratios were similar for all plankton types (10^4). For each component, plutonium isotope concentration ratios were consistently higher than values for americium and curium nuclides. Intra-element differences were observed for concentration ratios between the isotopes of plutonium (/sup 239,240/Pu > ^{238}Pu) and also the isotopes of curium (^{244}Cm > ^{243}Cm). An in-situ experiment monitoring sorption of the five transuranium isotopes by soil resulted in continued nuclide accumulation throughout a 15-day experiment with the overall soil nuclide concentrations positively correlated with nuclide concentrations in filtered water and/or seston. Model parameter estimates describing the fractional rates of increase were similar among ^{238}Pu, ^{241}Am, ^{243}Cm, and ^{244}Cm ranging from 4.4 to 0.59 x 10^{-3}/h to 6.0 +/- 0.70 x 10^{-3}/h. In contrast, this value for /sup 239,240/Pu, 1.3 +/- 0.43 x 10^{-3} was lower than for the other nuclides. Possible explanations for the observed similarities and differences in the distribution and kinetics of the five transuranium nuclides are discussed. 41 references, 8 figures, 5 tables.

4410 (CONF-841142—, pp 341-369) **Actinide behavior in a freshwater pond.** Trabalka, J.R.; Bogle, M.A.; Bondietti, E.A.; Scott, T.G. (Oak Ridge National Lab., TN). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW. Contract AC05-84OR21400.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Long-term investigations of solution chemistry in an alkaline freshwater pond have revealed that actinide oxidation state behavior, particularly that of plutonium, is complex. The Pu(V,VI) fraction was predominant in solution, but it varied over much of the range reported from other natural aquatic environments, in this case, because of intrinsic biological and chemical cycles. A strong positive correlation between plutonium (Pu) - but not uranium (U) - and hydroxyl ion over the observation period, especially when both were known to be in higher oxidation states, was particularly notable. Coupled with other examples of divergent U and Pu behavior, this result supports other evidence that Pu(V), or perhaps a mixture of Pu(V,VI), was the prevalent oxidation state in solution. Observations of trivalent actinide sorption behavior during an algal bloom, coupled with the association with a high-molecular-weight organic fraction in solution, indicated that solution-detritus cycling of organic carbon, in turn, may be the primary mechanism in americium-curium cycling. A significant difference in observed behavior between Am and Cm (25:1 in sediment-water exchange) is primarily attributable to reversible anthropogenic influences. Sorption by sedimentary materials appears to predominate over other factors controlling effective actinide solubility and may explain, at least partially, the absence of an expected strong positive correlation between carbonate and dissolved U. 39 references, 6 figures, 12 tables.

4411 (CONF-841142—, pp 371-390) **Effect of seasonal anoxia on the distribution of ^{238}Pu, /sup 239,240/Pu, ^{241}Am, ^{244}Cm, and ^{137}Cs in pond systems of the southeastern United States.** Alberts, J.J.; Bowling, J.W.; Orlandini, K.A. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The concentrations of ^{238}Pu, /sup 239,240/Pu, ^{241}Am, ^{244}Cm, and ^{137}Cs have been determined in the waters, sediments, and interstitial waters of two reservoirs located in the southeastern US. Limnological data are also presented which demonstrate that both reservoirs undergo thermal stratification with attendant hypolimnetic anoxia for significant periods in their annual hydrologic cycles. Seasonal concentration patterns of ^{137}Cs and the actinide elements are discussed relative to the hypothesis that seasonal anoxia of the hypolimnion and sediments can lead to remobilization of these elements from the sediments to the overlying water column. The results of this study support such a hypothesis for ^{137}Cs in both reservoirs. The data for /sup 239,240/Pu in one reservoir, however, indicate that no remobilization of that element has occurred in that system. In the second reservoir, the data show an increased concentration of ^{239}Pu, /sup 239,240/Pu, ^{241}Am, and ^{244}Cm in deep waters coincident with anoxic, hypolimnetic conditions. The data are not complete enough to delineate the source of the actinide elements in either the overlying water column or the sediments. It is suggested, however, that ^{239}Pu is being added from

an external source and that the chemically similar elements Am and Cm are being controlled by different mechanisms. 18 references, 7 figures, 10 tables.

4412 **(DP-MS—87-29) Radiometric analyses of floodplain sediments at the Savannah River Plant.** Lower, M.W. (Savannah River Lab., Aiken, SC (USA)). Sep 1987. Contract AC09-76SR00001. 11p. (CONF-8709104—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014841/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

A Comprehensive Cooling Water Study to assess the effects of reactor cooling water discharges and related reactor area liquid releases to onsite streams and the nearby Savannah River has been completed at the US Department of Energy's Savannah River Plant (SRP). Extensive radiometric analyses of man-made and naturally occurring gamma-emitting radionuclides were measured in floodplain sediment cores extracted from onsite surface streams at SRP and from the Savannah River. Gamma spectrometric analyses indicate that reactor operations contribute to floodplain radioactivity levels slightly higher than levels associated with global fallout. In locations historically unaffected by radioactive releases from SRP operations, Cs-137 concentrations were found at background and fallout levels of about 1 pCi/g. In onsite streams that provided a receptor for liquid radioactive releases from production reactor areas, volume-weighted Cs-137 concentrations ranged by core from background levels to 55 pCi/g. Savannah River sediments contained background and atmospheric fallout levels of Cs-137 only. 2 refs., 5 figs.

4413 **(EUR—10825) In situ radionuclide migration studies in a shallow and aquifer. Part. 1. Part. 2: appendices.** Williams, G.M.; Alexander, L.S.; Hitchman, S.P.; Hooker, P.J.; Noy, D.J.; Ross, C.A.M.; Stuart, A.; West, J.M. (British Geological Survey, Keyworth, UK). (Commission of the European Communities, Luxembourg). 1986. 189p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750664/JAW.

As a result of a study of the geology of the British Nuclear Fuels premises at Drigg, Cumbria, the British Geological Survey identified a shallow glacial sand deposit approximately 1.5m thick, interbedded between two clay horizons. An array of boreholes has been constructed in this sand in order to study the migration of radionuclides introduced into the formation under controlled conditions of groundwater flow. Conservative tracers used in the field test include chloride (as NaCl) and iodine-131 (as NaI). Strontium-85 (as the chloride) has been used as a chemically reactive tracer in conjunction with /sup 131/I. The principal research objectives of the programme are as follows: (1) To undertake laboratory batch sorption experiments using core material from the field site in order to choose those nuclides of radiological interest that would migrate sufficiently quickly for their behaviour to be studied in a field experiment within a reasonable time period. (2) To identify and quantify the mechanisms for nuclide/sediment interaction by determination of the geochemical distribution of /sup 85/Sr in contaminated cores using a sequential leaching procedure. (3) To obtain appropriate data on the hydraulic characteristics of the sand formation in order to construct a mathematical model to describe groundwater flow and reactive mass transport. Part 2 of this report contains the following appendices: (1) Calculation of sorption parameters. (2) A low-cost manifold system for use with multi-level samplers. (3) Radioactivity curves for /sup 131/I and /sup 85/Sr. (4) Results of particle size analysis for sand aquifers.

4414 (PTB-SE—14, pp 53-63) **Analysis and characterization of humic substances in the Gorleben site groundwater and their impact on the sorption behaviour of the actinides.** Buckau, G.; Zhuang, W.; Kim, J.I. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The paper reports the analysis and characterization of humic substances in site-specific groundwater of the projected Gorleben waste repository. The humic matter concentration of all water samples has been measured. Eleven samples have been selected for special examination, the humic substance components being separated and studied for their physical properties. The effect of humic matter on the dissolution of natural trace elements, especially of actinide homologues, and on the sorption behaviour of Np, Pu, Am, and Cm has been determined. The groundwater constituents have been analysed applying MS-NAA, HPIC, ICP-AES, and DOC analyser. Fractionation of colloidal species has been done by ultrafiltration and ultracentrifugation. The results show that trace metals are present in colloid form in the groundwater, and that there is a connection between colloid concentration and humic substances concentration. The behaviour of actinides in the groundwater is affected by the humic substances in that the sorption of actinides decreases with increasing humic matter concentration as a result of the formation of pseudocolloids.

4415 (PTB-SE—14, pp 77-89) **Predictions of radionuclide chemistry in a highly alkaline environment.** McKinley, I.; Berner, U.; Wanner, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Oct 1986. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

Equilibrium chemical thermodynamics is a powerful tool for evaluating elemental solubilities and speciation in aqueous solution. Application to nuclear waste problems is, however, somewhat limited by the availability of relevant data and hence many simplifying assumptions are generally involved in their use in this field. Background data are particularly sparse for the rather extreme chemical condition found in the pore waters of concrete or cement used as a waste matrix, backfill or structural component of a repository. In order to test these models, the natural concentrations and speciation of a number of relevant elements will be measured in natural hyperalkaline springs in Oman (in collaboration with the British Geological Survey). In this paper, this natural analogue study will be described in more detail and predicted speciation, solubility and migration properties will be presented.

4416 (PTB-SE—14, pp 100-112) **Specification of actinides in ground waters by means of laser-induced, photoacoustic spectroscopy (LPAS).** Klenze, R.; Stumpe, R.; Kim, J.I. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). Oct 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

LPAS is explained as the novel, very sensitive spectroscopical method allowing speciation of actinides in natural aquatic systems. The information yield of LPAS corresponds to that of the conventional absorption spectroscopy; but its sensitivity is better by 2 to 3 orders of magnitude, so that for example 2 x 10/sup -8/ mol/L Am/sup 3+/ could be measured. Principles and method of LPAS are described, and its application to the investigation of the hydrolysis reaction of Am/sup 3+/ and the behaviour of Am/sup 3+/ in various types of ground water.

4417 (PTB-SE—14, pp 293-307) **Colloid generation and solid-liquid distribution of transuranic elements in natural aquifer systems.** Kim, J.I.; Rommel, H. (Technische Univ. Muenchen, Garching, Germany, F.R. Inst. fuer Radiochemie). Oct 1986. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750429/JAW. (CONF-8604362—).

From 66. PTB-seminar on chemistry and migration behaviour of the actinidies and fission products in natural aquatic systems; Garching, F.R. Germany (24 Apr 1986).

The sorption and desorption behaviour of transuranic elements in the presence of their pseudocolloids has been investigated in deep geological aquifer systems at Gorleben area. The generation of transuranic colloids and their influence on the determination of

distribution coefficients in a laboratory experimental system are evaluated quantitatively. Discussion is made on the possible extrapolation of laboratory results to natural systems.

4418 **(STUK-A—60) Radioactivity of surface water in Finland after the Chernobyl accident in 1986. Supplement 5 to annual report STUK-A55.** Saxen, R.; Aaltonen, H. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jun 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753048/JAW.

After the Chernobyl accident the distribution of deposited radioactive substances in the surface water of different drainage basins has been monitored with an extensive programme. Monitoring of the radioactivity transported by the largest rivers to the Baltic Sea, which started in the early 1960s, was also continued. The radioactivity of the water in some lakes, which are used as drinking water basins, was also controlled. Some analyses were carried out both on untreated water and on drinking water after the treatment process. All samples were analysed gammaspectrometricallly. /sup 89/Sr and /sup 90/Sr were also determined on the majority of the samples. Some samples were analysed for tritium. Altogether ten different artificial gamma-emitting radionuclides were detected in surface water samples. The most important of these were iodine-131, which was detected for only a short time after the accident, and cesium-134 and -137. The uneven distribution of Chernobyl deposition can be seen in the results. The highest concentrations of radionuclides were detected in the Kokenmaenjoki and Kymijoki drainage basins. The different behaviour of the two long-lived radionuclides /sup 137/Cs and /sup 90/Sr is apparent, although the increase in /sup 90/Sr caused by the Chernobyl accident was small compared with the increase of /sup 137/Cs. Deposited cesium was removed quickly from the water phase. The activity consentrations decreased until October so that there remained only 10 - 30 % of the values of May in the main deposition area. On the contrary, strontium remained better in the water phase. In the water treatment process a notable amount of the deposited /sup 137/Cs was removed.

4419 **(YJT—86-13) Factors affecting actinide solubility in a repository for spent fuel, 1.** Snellman, M. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Jul 1986. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753052/JAW.

The main tasks in the study were to get information on the chemical conditions in a repository for spent fuel and information on factors affecting releases of actinides from spent fuel and solubility of actinides in a repository for spent fuel. The work in this field started at the Reactor Laboratory of the Technical Research Centre of Finland (VTT) in 1982. This is a report on the effects on the main parameters, Eh, pH, carbonate, organic compounds, colloids, microbes and radiation on the actinide solubility in the nearfield of the repository. Another task has been to identify available models and reported experience from actinide solubility calculations with different codes. 167 refs.

4420 **(YJT—87-05) Dissolution mechanism of UO/sub 2/ in groundwater.** Ollila, K. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Apr 1987. 87p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753050/JAW.

The effects of different phenomena include the oxidative dissolution, formation of secondary phases (precipitation) on the surface of fuel matrix or elsewhere in groundwater, adsorption of the uranium species on particles in groundwater and formation of colloids. Finally, the modelling of UO/sub 2/ dissolution has been discussed. In the experimental part the dissolution of the UO/sub 2/ pellets under different parametric conditions in two synthetic groundwaters has been investigated. The synthetic groundwater I is simulatingthe undisturbed chemical conditions deep in granitic bedrock and the synthetic groundwater II is simulating the effects of bentonite. The pH and redox conditions were varied. The experimental solubility in synthetic groundwater I under oxidizing conditions varied 5.0 x 10/sup -4/...4.0 x 10/sup -3/ g U/l. Adsorbed and/or precipitated uranium was found in the waters. The surface analyses did not reveal the formation of secondary phases on the surface of the pellets in synthetic groundwater I. No increase in the uranium solubility in synthetic groundwater II was observed in spite of the higher carbonate content, the values varied 9.0 x 10/sup -6/...4 x 10/sup -3/ g U/l. The formation of secondary phase was observed in synthetic groundwater II in the progress of dissolution, probably having passivating effect on further dissolution. The lowest solubility values were measured at the end of the latest dissolution period. The experimental solubilities in synthetic groundwaters I and II varied under reducing conditions 2.7 x 10/sup -6/...6.9 x 10/sup -5/ and 9.0 x 10/sup -7/...3.9 x 10/sup -5/ g U/l, respectively. The analyzing of the oxidation state of uranium revealed that dissolved uranium was partly in the oxidation state of VI. (Abstract Truncated)

4421 **Anomalous binding of organic contaminants may be artifactual due to radiochemical impurities.** McCarthy, J.F.; Jimenez, B.D.; Southworth, G.R.; DiToro, D.M.; Black, M.C. (Oak Ridge National Lab., TN, USA; Manhattan Coll., New York, USA; Tennessee Univ., Knoxville, USA). *Water Research;* **20**: No. 10, 1251-1254(Oct 1986).

A potential artifact is described that could lead to erroneous estimates of the partition coefficients for binding of contaminants to sorbents such as soil, sediment, or dissolved humic material. The artifact can arise if sorbents are radiolabeled but contain even relatively small amounts of radiolabeled impurities. The following types of errors could result from data affected by this artifact: partition coefficients for sorption could be underestimated; systems in which binding was fully reversible could appear to be at least partially nonreversible and partition coefficients could appear to decrease as the sorbent concentration increased. Several criteria are suggested to assure that experimental results are not affected by this artifact.

4422 **Environmental fate and distribution of technetium-99 in a deciduous forest ecosystem.** Garten, C.T. Jr.; Tucker, C.S.; Walton, B.T. (Oak Ridge National Lab., TN, USA). *Journal of Environmental Radioactivity (London);* **3**: No. 3, 163-188(1986).

The uptake of ^{99}Tc by trees intercepting contaminated groundwater from a radioactive waste storage site was measured to identify the major ^{99}Tc pools within the woodland ecosystem and to assess the relative mobility of ^{99}Tc in the existing element cycle. The highest average ^{99}Tc concentrations in vegetation were found in herbaceous plants. Tree wood was the major above-ground pool for ^{99}Tc because of the high concentrations in wood as well as the large amount of wood relative to other biomass at the site. Technetium was not easily leached from the trees by rainfall and was not readily extractable from forest floor leaf litter by water. The relative importance of return pathways for ^{99}Tc to the forest floor was leaf fall > stemflow > throughfall, indicating that ^{99}Tc was conserved by the trees. Snails and millipedes from the leaf litter layer concentrated technetium 20- and 16-fold, respectively, above levels found in the soil. Pertechnetate was rendered less bioavailable after ingestion by a leaf litter macroinvertebrate (Porcellio sp.) common to the study site.

4423 **Partition coefficients for ^{244}Cm on freshwater and estuarine sediments.** Sibley, T.H.; Wurtz, E.A.; Alberts, J.J. (Washington Univ., Seattle, USA. Lab. of Radiation Ecology; Savannah River Ecology Lab., Aiken, SC, USA). *Journal of Environmental Radioactivity (London);* **3**: No. 3, 203-217(1986).

Sediment-water partition coefficients of ^{244}Cm were determined in laboratory constant-shaking experiments using sediments and water from several freshwater and estuarine environments. Values in excess of 5 x 10^4 ml g^{-1} indicate that curium is tightly bound to natural sediments. Previously reported values for americium are equivalent to these curium values but plutonium values were lower. Adsorption is pH dependent increasing from pH 4 to pH 7. In some organic-rich systems, adsorption decreases above pH 7 although it remains high in carbonate-buffered waters. Dissolved organic compounds appear to stabilize curium in the soluble phase although interactions between pH, dissolved and particulate organic matter are not well defined. Adsorption rates are reduced by dissolved organic compounds but apparent equilibrium is generally attained within several days or weeks. These rates should not affect

long-term models of biogeochemical cycling but may alter hydrologic predictions of curium transport in surface waters.

4424 Distribution of plutonium, americium and curium isotopes in pond and stream sediments of the Savannah River Plant, South Carolina, USA. Alberts, J.J.; Halverson, J.E.; Orlandini, K.A. (Savannah River Ecology Lab., Aiken, SC, USA; Savannah River Lab., Aiken, SC, US; Argonne National Lab., IL, USA). *Journal of Environmental Radioactivity (London);* 3: No. 4, 249-271(1986).

The concentrations of ^{238}Pu, $^{239,240}Pu$, ^{241}Am and ^{244}Cm were determined in sediment samples from five streams and two ponds on the Savannah River Plant (SRP) and in four sediment samples from the Savannah River above and below the plant site. The following concentration ranges were determined: ^{238}Pu, 0.07-386 fCi g^{-1}; $^{239,240}Pu$, 0.37-1410 fCi g^{-1}; ^{241}Am, 0.1-4360 fCi g^{-1}; ^{244}Cm, <0.01-392 fCi g^{-1}. Comparisons of the elemental and isotopic ratios of the sediments show that the majority of the sediments studied have been impacted upon by plant operations and that sediments outside the plant boundary in the Savannah River have only been influenced by aerial releases. Atom ratios of $^{240}Pu/^{239}Pu$ indicate that up to 86% of the Pu in these sediments is derived from plant operations. However, comparisons of the concentration data with values for other impacted sediments near nuclear facilities indicate that the levels are relatively small. Finally, <13% of the Pu, Am or Cm in pond sediments is associated with humic or fulvic acids, indicating that little of the material should be remobilized in oxic environments through organic complexation.

5204 Thermal Effluents Monitoring And Transport

4425 (DOE/BP/16480—3) Development of a vaccine for bacterial kidney disease in salmon: Annual report, FY 1986. Kaattari, S.; Holland, N.; Turaga, P.; Weins, G. (Oregon State Univ., Corvallis (USA). Dept. of Microbiology; USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Jun 1987. Contract AI79-84BP16480. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000448/JAW.

The project tests the immunogenicity and prophylactic value in coho salmon (Oncorhynchus kisutch) of various chemical conjugates of Renibacterium salmoninarum cells and major antigens. We assessed the serum antibody response, the cellular immune response (cellular proliferation), and the kinetics of mortality after lethal injections of the bacterium. The identification and isolation of virulence factors are not only important to the dissection of the mechanism of pathogenesis of bacterial kidney disease, but the purification of such a factor(s) will insure the production of a more potent vaccine. The studies have identified antigenic material; identified antigenic material which can exacerbate the disease; identified a possibly major mechanism of pathogenesis via the interference with antibody; refined a western blot technique for identification of infected fish; described the use of monoclonal antibodies for antigenic analysis; and identified an unusual and dramatic effect of R. salmoninarum cells on phagocytic function. 37 refs., 26 figs.

4426 (DOE/ER/60529—T1) Site specificity and movement of largemouth bass (Micropterus salmoides) in a thermally altered reservoir. Tuel, T.A. (State Univ. of New York, Buffalo (USA). Dept. of Biology). Dec 1986. Contract FG02-87ER60529. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014994/JAW.

A mark-recapture experiment was conducted in Pond C, a thermally altered reservoir in the Par Pond system of the Savannah River Plant. The standing crop for bass spread throughout the reservoir was 2.7 to 3.8 kg/ha. From the length/mass relationships, for a given total length, Pond C bass weighed less than bass from other lakes and reservoirs and had a lower condition coefficient than bass from normal lakes and reservoirs. Bluegill (Lepomis macrochirus) were found, from the length/mass relationships, for a given length, to weigh less than bluegill in other lakes and reservoirs and also had a low condition coefficient which was similar to bluegill found in thermally impacted lakes and reservoirs. Thus, bluegill in Pond C and other thermally affected reservoirs, like bass, also suffer a loss of body condition due to the thermal and trophic stresses in these systems. The rate at which bass move out of the refuge areas (24 m per day) is lower than the rate at which bass move in other lakes and reservoirs. Bluegill move (23 m per day) out of the refuge areas at a rate similar to that of bass. 43 refs., 12 figs., 9 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 3055, 3223, 3224, 3225, 3226, 3227, 3228, 3229, 3231, 3232, 3233, 3234, 3235

4427 (GAO/RCED—86-139BR) Water resources: Implementation of the Bureau of Reclamation's safety of dams program. (General Accounting Office, Washington, DC (USA)). 1986. 26p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Bureau of Reclamation has inspected all of the 275 dams in its safety program, has completed detailed safety analyses on 125 dams, and plans to complete the safety analysis on the remaining dams by FY 1994. As of October 1985, the Bureau had corrected safety deficiencies at 13 dams at a cost of $31 million. The Bureau has identified 67 dams as needing modification for which $750 million has been authorized.

4428 (GAO/RCED—87-31) Water resources: Delaware River Basin Commission's management of certain water activities. (General Accounting Office, Washington, DC (USA)). 1987. 65p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Delaware River Basin serves the states of New York, New Jersey, Pennsylvania, and Delaware. Since 1975 the Commission has shifted its emphasis from constructing water resource projects to using water conservation techniques and strategies in order to meet water supply and streamflow needs. Its 1980 population growth projection for the basin was generally accurate, but data on water use are not always collected or reliable. The Commission's policies for approving permits for large users of water have become more restrictive within the past 6 years, but except for major projects, permits are approved without knowledge of their impact on streamflow in the basin.

4429 (OH/R—87/17/K) Nonlinear modelling of prawn growth. Ration curves. Bartlett, S.A. (Ontario Hydro, Toronto (Canada). Research Div.). 26 Jan 1987. 19p. (MICROLOG—87-04192). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Biology Section of Ontario Hydro's Chemical Research Department has been conducting a series of experiments to study methods of raising prawns (large freshwater shrimp) efficiently and economically. The purpose is to make commercial use of the warm water available near generating stations in which prawns could adapt well. Prawns are of particular interest because they are a premium priced food product, have a rapid growth rate, and are easy to raise in captivity. One of these experiments was conducted to estimate the relationship between prawn growth and size of food ration. A nonlinear equation was used to model the growth-ration relationship. 9 figs., 2 tabs.

5206 Regulations

REFER ALSO TO CITATION(S) 4395, 4399

4430 (PB—87-218210/XAB) Groundwater-quality-protection policies for the Rocky Mountain Region and the nation. (Colorado State Univ., Fort Collins (USA). Water Resources Research Inst.). Apr 1986. 220p. (INFORMATION-SER—56). NTIS, PC A10/MF A01.

Transcript of a conference held at Denver, Colorado, January 18, 1986.

This report is a transcript of the Conference on Groundwater Quality Protection Policies for the Rocky Mountain Region and the Nation held in Denver, Colorado on January 18, 1986. The conference, and five others like it in other regions of the country,

were held to provide input for a groundwater-protection agenda for the U.S. Congress as it begins debate on new groundwater-quality-protection initiatives. The conference featured roundtable discussions among officials from the sponsoring organizations, local and state officials, environmentalists, corporate representatives, farm groups, and others on groundwater-protection needs and current programs in the region. Also considered were federal policy options, legislation, and mechanisms to implement groundwater policies.

4431 **(PB—87-221560/XAB) Recommended biological indices for 301(h) monitoring programs. Final report.** Bilyard, G.R.; Brooks-McAuliffe, M.B. (Tetra Tech, Inc., Bellevue, WA (USA)). Mar 1987. 23p. (TETRAT-TC—3953-03). NTIS, PC A02/MF A01.

The purpose of this document is to develop recommendations of those indices that should be used in the interpretation of 301(h) biological monitoring data. The Bray-Curtis similarity index, flexible sorting strategy, group-average sorting, dominance index, infaunal index, biomass estimates, Hurlbert's PIE diversity index, and the Shannon-Wiener H' index are discussed and evaluated.

4432 **(PB—87-226759/XAB) Quality criteria for water, 1986.** (Environmental Protection Agency, Washington, DC (USA). Office of Water Regulations and Standards). 1 May 1986. 402p. (EPA—440/5-86/001). NTIS, PC A18/MF A01.

Also available from Supt. of Docs.

Section 304(a) (1) of the Clean Water Act 33 U.S.C. 1314(a) (1) requires the Environmental Protection Agency (EPA) to publish and periodically update ambient water-quality criteria. These criteria are to accurately reflect the latest scientific knowledge (a) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish shellfish, wildlife, plant life, shorelines, beaches, aesthetics, and recreation that may be expected from the presence of pollutants in any body of water including ground water; (b) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (c) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and organic and inorganic sedimentation for varying types of receiving waters. In a continuing effort to provide those who use EPA's water-quality and human-health criteria with up-to-date criteria values and associated information, the document was assembled. The document includes summaries of all the contaminants for which EPA has developed criteria recommendations.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 2976, 3139, 3540, 3549, 4513

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 3465, 3536, 3537

4433 **(DOE/EIS—0129F) New England/Hydro-Quebec +-450 kV transmission line interconnection: Phase 2: Final environmental impact statement.** (USDOE Economic Regulatory Administration, Washington, DC. Office of Fuels Programs). Aug 1987. 454p. NTIS, PC A20. Order Number DE88000281/JAW.

The proposed action is the issuance of an amendment to Presidential Permit PP-76 to the Vermont Electric Transmission Company to operate the international interconnection therein authorized at power levels above those stipulated in PP-76, and to construct new transmission facilities to distribute this power. The proposed new facilities, referred to as Phase II, consist of the extension of the Phase I +-450-kV dc transmission line (predominantly along existing transmission rights-of-way) between the town of Monroe, New Hampshire (the terminus of Phase I) and the town of Groton, Massachusetts; the construction of an 1800-MW dc/ac converter terminal at the terminus of the proposed dc line; and the construction of two new linearly connected 345-kV ac transmission lines along existing transmission rights-of-way and terminating at an existing substation at West Medway, Massachusetts. These new transmission lines are needed to reinforce the existing New England 345-kV ac transmission system and thereby allow the NEPOOL system to operate reliably at the higher levels of import. The principal environmental impacts of the construction and operation of the transmission facilities will be incremental in nature and will include the conversion of a small amount of primarily forested land to right-of-way (shrubland/grassland vegetation) or to other project-related uses, and minor visual impacts. Many references are included.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 4036

4434 **(PB—87-214235/XAB) Medical subject headings, annotated alphabetic list, 1988.** (National Library of Medicine, Washington, DC (USA)). Jul 1987. 961p. (NLM/MED—87/01). NTIS, PC E09/MF E04.

Supersedes PB—86-227774. See also PB—87-214243.

Alphabetic list of all subject descriptors used by indexers and catalogers at the National Library of Medicine. The document includes: Subject headings; Cross references; Geographic headings; Non-MeSH terms; Check tags; Tree numbers; and Notes for indexers, catalogers, and online searchers.

4435 **Observation of acoustic umklapp-phonons in water-stabilized DNA by neutron scattering.** Grimm, H.; Stiller, H.; Majkrzak, C.F.; Rupprecht, A.; Dahlborg, U. (Kernforschungsanlage Juelich, D-5170 Juelich, West Germany). *Physical Review Letters;* **59**: No. 15, 1780-1783(12 Oct 1987).

We have investigated static and dynamic properties of wet-spun DNA fibers in their C, A, and B conformations using the thermal neutron scattering. Over-damped and underdamped longitudinal acoustic umklapp phonons are observed in the vicinity of a hydration-dependent two-dimensional sheet of diffuse scattering perpendicular to the helix axis. A quantitative analysis of this mode is presented for the B-DNA sample in terms of a harmonic one-dimensional liquid, i.e., taking into account all orders of fluctuations. The resulting effective dispersion does not extrapolate to zero frequency at the position of the sheet.

5501 Behavioral Biology

4436 **(CONF-8710124—4) A Darwinian approach to artificial neural systems.** Dress, W.B.; Knisley, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87013184/JAW.

From IEEE international conference on systems, man, and cybernetics; Alexandria, VA, USA (20 Oct 1987).

Self-organization in artificial neural systems and simulated genetic methods for determining functional parameters of such systems have been combined. This leads to a model of the genome as a self-organizing system on a supra-organism level, and to suggestions for a number of experiments to be performed on the abstract genetic space. The problem of the open system is also addressed in this model. A synthetic intelligent system is viewed as an extensible set of parameters-the evolved genome. This set also serves as a specification file for individual synthetic organisms, and algorithms for network-construction use this set as data for creating specific networks. It is this set of parameters that undergoes mutation and selection leading to a synthetic organism fulfilling the goals of the systems designer. 22 refs., 4 figs.

4437 **(LA—11140-MS) A model of the neocortex.** Mycielski, J.; Swierczkowski, S. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001303/JAW.

We try to model the cerebral cortex by representing it as a large array of small computers, each of which applies a certain algorithm for learning to predict the inputs from the senses or other parts of the brain. This view ignores the role of the brain as a classifying device, but it puts forward its role as a learner of the laws of evolution of sequences of patterns. Memory is not seen here as a list of facts but as an operator predicting certain parameters of the future states of reality from its present and past states.

4438 **(LA-UR—87-2881) Dimensional analysis of nonlinear oscillations in brain, heart and muscle.** Mayer-Kress, G.; Yates, F.E.; Benton, L.; Keidel, M.; Tirsch, W.; Poeppl, S.J.; Geist, K. (California Univ., San Diego, La Jolla (USA). Lab. for Biological Dynamics and Theoretical Medicine; California Univ., Los Angeles (USA). Crump Inst. for Medical Engineering; Los Alamos National Lab., NM (USA); Technische Univ. Muenchen (Germany, F.R.). Neurologische Klinik und Poliklinik; Goettingen Univ. (Germany, F.R.). 3. Physikalisches Inst.). 1987. Contract W-7405-ENG-36. 51p. (CONF-8705193—2). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014749/JAW.

From CNLS workshop on nonlinearity in biology and medicine; Los Alamos, NM, USA (18 May 1987).

We present some numerical studies on the dimensional analysis of temporal oscillations measured in the human electroencephalogram (EEG), heart rates (HR), and muscle tremor. We show that it is sufficient to characterize the individual system by a single dimension value alone. We give some detailed numerical analysis of the scaling structure of the attractors reconstructed from the time signal. Our methods are based on the concept of local gauge functions that we derive from the raw signals as well as from the transformed signal obtained from singular value decomposition. We were able to confirm and improve earlier results on the change of dimensionality of EEG signals. For heart rates and muscle tremor we observe significant changes in the dimensionality depending on the state of the system. We indicate which factors enter dimension estimates and where specific problems lie in each of the examples. 51 refs., 27 figs.

5502 Biochemistry

REFER ALSO TO CITATION(S) 3254, 4436, 4541, 4555, 4556

4439 **High surface area catalysts for H_2 reduction of an enzyme: reduction of NAD^+ to NADH.** Chao, S.; Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge). *Journal of the American Chemical Society;* **109**: No. 19, 5886-5888(16 Sep 1987).

This paper describes the catalytic reduction of NAD^+ using a pyridine-derived redox polymer and H_2. The enzymes formate dehydrogenase or lipamide dehydrogenase have been used to mediate the reaction; a platinum catalyst is also required to activate molecular H_2. The redox polymer, designated (PQ^{2+} x pt)/sub n/ was anchored on high surface area SiO_2. The system is presented as a viable means of equilibrating the H_2O/H_2 redox system with catalytically active redox enzymes, thus establishing the viability of using H_2 as a reductant in enzymatic processes.

4440 **Axial ligation-induced structural changes in nickel hydrocorphinoids related to coenzyme F_{430} detected by Raman difference spectroscopy.** Shelnutt, J.A. (Sandia National Labs., Albuquerque, NM). *Journal of the American Chemical Society;* **109**: No. 14, 4169-4173(8 Jul 1987). Contract AC04-76DP00789.

Raman difference spectroscopy provides a structural probe of the state of axial ligation of Ni(II) in nickel corphinoids of the type occurring in coenzyme F_{430} of the methylreductase enzyme of methanogenic bacteria. The two model nickel corphinoids investigated, which have all of the structural features of the natural chromophore, were synthesized by A. Faessler, A. Pfaltz, and A. Eschenmoser. Raman lines analogues to the core-size marker lines of metalloporphyrins are identified for the Ni corphinoids, and, just as for the Ni porphyrins, the frequencies for the group of Raman marker lines characterize the 4-, 5-, and 6-coordinate complexes. Further, complexes with two strong nitrogenous bases (e.g., piperidine) can be distinguished from complexes with weak basic ligands (e.g., methanol) on the basis of the frequencies of these Raman lines. Finally, Raman spectra of polycrystalline samples of the Ni corphinoid and its monoisothiocyante complex show that the structures existing in solution differ markedly from the structures in the crystalline state. The Raman markers will be useful in elucidating the structure of coenzyme F_{430} and its interaction with the nearby protein environment in component C of the methyl-S-coenzyme-M reductase system.

4441 **Expression of a Thermomonospora fusca cellulase gene in Streptomyces lividans and Bacillus subtilis.** Ghangas, G.S.; Wilson, D.B. (Cornell Univ., Ithaca, NY). *Applied and Environmental Microbiology;* **53**: No. 7, 1470-1475(Jul 1987). Contract FG02-84ER13233.

A cellulase gene from Thermomonospora fusca coding for endocellulase E_6 was introduced into Streptomyces lividans by using shuttle plasmids that can replicate in either S. lividans or Escherichia coli. Plasmid DNA isolated from E. coli was used to transform S. lividans, selecting for thiostrepton resistance. The transformants expressed and excreted the endocellulase, but the ability to produce the endocellulase was unstable. This instability was shown to result from deletion of the endocellulase gene from the plasmid. Plasmid DNA prepared from a culture in which plasmid modification had occurred was used to transform E. coli, selecting for Amp^+ cells, and all of the transformants were cellulase positive, showing that pBR322 and T. fusca DNA were deleted together. When a plasmid was constructed containing only T. fusca DNA in plasmid pIJ702, the transformants were more stable, and the level of endocellulase activity produced in the culture supernatant after growth on 0.2% glucose was close to the level produced by T. fusca cultures grown on 0.2% cellulose. About 50% of the total protein in the culture supernatant of the S. lividans transformant was endocellulase E_6. The enzyme produced by the S. lividans transformant was identical to pure T. fusca E_6 in its electrophoretic mobility and was completely inhibited by antiserum to E_6. Shuttle plasmids containing the E_6 gene that could replicate in Bacillus subtilis and E. coli were also constructed and used to transform B. subtilis. Again there was extensive deletion of the plasmid DNA during transformation and growth in B. subtilis. There was no evidence of E_6 activity, even in those B. subtilis transformants that retain the E_6 gene.

4442 **Role of active potassium transport in the regulation of cytoplasmic pH by nonanimal cells.** Blatt, M.R.; Slayman, C.L. (Yale Univ. School of Medicine, New Haven, CT). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 9, 2737-2741(May 1987).

High-affinity potassium uptake in Neurospora occurs by symport with protons, for which a large inward gradient generated by the H^+-extruding ATPase of the plasma membrane. Operating in parallel, the two transport systems yield a net 1:1 exchange of K^+ for cytoplasmic H^+. Since this exchange could play a role in cytoplasmic pH (pH/sub i/) regulation, the coordinated functioning of the K^+-H^+ symport and H^+ pump has been examined during acid stress. Cytoplasmic acid loads were imposed by injection and by exposure to extracellular permeant weak acid. Multibarrelled microelectrodes were used to monitor membrane potential (V/sub m/), pH/sub i/, and the current-voltage (I-V) characteristics of the cells. The behaviors of the H^+ pump and K^+-H^+ symport were resolved, respectively, by fitting whole membrane I-V curves to an explicit kinetic model of the neurospora membrane and by subtracting I-V curves obtained in the absence from those obtained in the presence of 5-200 μM K^+ outside. Potassium import via the symport leads to a measurable alkalinization of the cytoplasm in accordance with stoichiometric (1:1) K^+/H^+ exchange. Potassium transport is accelerated at low pH/sub i/, but in a manner consistent with its inherent voltage sensitivity and changes in V/sub m/ resulting from an increased rate of H^+ extrusion by the pump. The primary response to acid stress thus rests with the H^+ pump, but

K^+ transport introduces an essential kinetic valve that can regulate net H^+ export.

4443 **Coordinate regulation of stromelysin and collagenase genes determined with cDNA probes.** Frisch, S.M.; Clark, E.J.; Werb, Z. (Univ. of California, San Francisco). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 9, 2600-2604(May 1987). Contract AC03-76SF01012.

Secreted proteinases are required for tumor metastasis, angiogenesis, and tissue remodeling during wound healing and embryonic growth. Thus, the regulation of the genes of secreted proteinases may serve as an interesting model for growth-controlled genes in general. The authors studied the genes of the secreted proteinases stromelysin and collagenase by using molecularly cloned cDNAs from each proteinase. Stromelysin cDNA was cloned by differential screening of a total cDNA library from rabbit synovial cells treated with phorbol 12-myristate 13-acetate, which yielded a clone of 1.2 kilobase pairs; collagenase cDNA was obtained by cloning reverse transcripts of anti-collagenase-immunoadsorbed polysomal mRNA, which yielded a clone of 0.8 kilobase pairs. Stromelysin and collagenase mRNA species of 2.2 and 2.4 kilobases, respectively, were detected on hybridization blots of RNA from phorbol 12-myristate 13-acetate-treated but not untreated rabbit synovial cells. Expression of stromelysin mRNA was also induced in rabbit alveolar macrophages and rabbit brain capillary endothelial cells treated with phorbol 12-myristate 13-acetate. Stromelysin and collagenase mRNA were both induced by phorbol 12-myristate 13-acetate and cytochalasin B at a constant ratio of the two gene products; this suggest coordinate regulation. The fact that induction was blocked after inhibition of protein synthesis by cycloheximide implicates an indirect signal transduction pathway that requires new protein synthesis.

4444 **Phycobilisome composition and relationship to reaction centers in Anacystis nidulans.** Khanna, R.; Graham, J.R.; Myers, J.; Gantt, E. pp 11.7.695-11.7.698 of Advances in photosynthesis research. Volume II. Sybesma, C. (ed.). Hague, Netherlands; Martinus Nijhoff/Dr. W. Junk Publishers (1983). Contract AS05-76ER04310.

Phycobilisomes were studied in Anacystis nidulans wild type and several spontaneous mutants selected for improved growth in far-red light ($>$ 650 nm). In the mutants the phycocyanin varied in relation to allophycocyanin but there was no alteration in the antenna size in terms of chlorophylls in photosystems I and II. Phycobilisomes of wild-type contained phycocyanin and allophycocyanin in a molar ratio of 3:1. Phycobilisomes of the mutants 85Y, 19Y and 59G had respective ratios of 0.4:1, 0.7:1, and 1:1. Analysis of purified phycobilisomes on SDS-PAGE gradient gels revealed significant differences in the polypeptide pattern. A comparison of phycobilisomes of the wild-type and 85Y by electron microscopy, showed that they were larger in wild-type (57nm x 30nm) than in 85Y (28nm x 15nm). The number of phycobilisomes per cell ($\sim 2 \times 10^4$) was about the same in wild-type (white light) and 85Y (far-red light). The ratio of phycobilisome/reaction center 2 was close to 1 and was relatively constant in spite of large variations in chlorophyll and in phycocyanin content. 5 references, 2 figures, 2 tables.

5503 Cytology

REFER ALSO TO CITATION(S) 4499

5504 Genetics

REFER ALSO TO CITATION(S) 3206, 3254, 4436, 4490, 4495, 4496, 4556

5505 Metabolism

REFER ALSO TO CITATION(S) 3255, 4496

4445 **Carbohydrate utilization by the ischemic perfused heart: an NMR analysis.** Brainard, J.R.; Hutson, J.Y.; Hoekenga, D.E.; Lenhoff, R.J. (Los Alamos National Lab., NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2010(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

During ischemia, carbohydrate is necessarily the primary fuel for generation of energy by anaerobic glycolysis. The relative contributions of glycogen and exogenous glucose to glycolysis in the ischemic guinea pig heart were determined by ^{13}C labeling and NMR. Glycogen was labeled by preischemic perfusion with [1-^{13}C]glucose. [2-^{13}C]glucose was then supplied in fresh perfusate during 17 minutes of ischemia. Insulin was included in each case. The relative contribution of glycogen and glucose to glycolysis was determined from ^{13}C spectra obtained during ischemia and by analysis of ^1H spectra of lactate isolated from hearts freeze-clamped at the end of ischemia. The relative amounts of [2-^{13}C]lactate, [3-^{13}C]lactate, and natural abundance lactate produced during ischemia correspond to contributions to glycolysis by [2-^{13}C]glucose, [1-^{13}C]glycogen, and natural abundance glycogen, respectively. Glucose utilization during 17 minutes of ischemia, determined from integration of labeled lactate peaks from ^{13}C spectra, increased from 11 to 35% of the labeled carbohydrate utilization when perfusate glucose increased from 3 to 11.7 mM. Analysis of labeled lactate formation as a function of time during ischemia suggests that glucose is preferentially utilized early during the ischemic period. They conclude that glucose can contribute significantly as a fuel source in the ischemic heart; the extent depends on the concentration of glucose available to the heart and on the duration of ischemia.

5506 Medicine

REFER ALSO TO CITATION(S) 3181, 3259, 3546, 3813, 3901, 3908, 3910, 3911, 3912, 3913, 3913, 4376, 4443, 4502, 4530, 4535, 4536, 4538, 5135

4446 **(CEA-CONF—8928) Pharmacological studies of the lung with PET.** Syrota, A. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). Oct 1986. 11p. (CONF-8610318—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753246/JAW.

From Workshop on clinical efficacy of positron emission tomography; Koeln, F.R. Germany (23 Oct 1986).

Positron emission tomography (PET), known to be used for lung ventilation and perfusion studies, can also be used in pharmacology to obtain information that is otherwise not available. The lung takes up biologically active substances which can be inactivated or activated, and synthesises and releases others. Such information in man has been obtained from samples of human lungs, or from in vivo first-pass studies, invasive or not, as well as from in vivo kinetic studies using external detection methods with scintillation cameras. PET provides now quantitative regional data in the human lung.

4447 **(DOE/ER/60401—18) [Fluorine-18 labeled androgens and progestins; imaging agents for tumors of prostate and breast]: Technical progress report, February 1, 1987-January 31, 1988.** Katzenellenbogen, J.A. (Illinois Univ., Urbana (USA)). 1987. Contract FG02-86ER60401. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000808/JAW.

This project develops fluorine-18 labeled steroids that possess high binding affinity and selectivity for androgen and progesterone receptors and can be used as positron-emission tomographic imaging agents for prostate tumors and breast tumors, respectively. These novel diagnostic agents may enable an accurate estimation of tumor dissemination, such as metastasis of prostate cancer and lymph node involvement of breast cancer, and an in vivo determination of the endocrine responsiveness of these tumors. They will provide essential information for the selection of alternative therapies thereby improving the management of prostate and breast cancer patients. 14 refs., 1 tab.

4448 **(DOE/ER/60434—2) Synthesis of radiopharmaceuticals containing short-lived radionuclides: Progress report, March 1, 1987-February 28, 1988.** Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Sep 1987. Contract FG05-86ER60434. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000162/JAW.

The objective is the creation of new methods for introducing short-lived isotopes into agents for use in diagnostic nuclear medicine. Focus is on the design of new molecular architecture as opposed to the application of known reactions to the synthesis of specific radiopharmaceuticals. The new technology is utilized in nuclear medicine research at the University of Tennessee Medical Imaging Center and in collaboration with colleagues at other DOE facilities. The program provides training for students in the scientific aspects of nuclear medicine. The academic nature of the program facilitates collaborative interactions with other DOE nuclear medicine programs and helps to insure the continued availability of skilled scientists dedicated to the advancement of nuclear medicine. 70 refs., 9 figs.

4449 **(INIS-mf—10950) Study and establishment of a computer program for radiotherapy treatment planning development.** Djennaoui, N. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Feb 1987. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700033/JAW.

The modern radiotherapy requires the use of computers. In addition to their accuracy, computers involve an appreciable saving of time in the calculation of isodoses, permitting us to change several times a technique in order to choose the best dose distribution for each case of tumor. The aim of this work was to set a computer program calculating a suitable dose distribution for a given treatment. The algorithm of calculation of the depth dose used in our program permits us to calculate the dose distribution for all photon energies used in radiotherapy, whatever are the energy and modification of the field by the use of wedge filters or bolus.

4450 (INIS-mf—10996, pp 41-42) **Comparison of radiation dose for dacryocystographic examinations.** Karnel, F.; Canigiani, G.; Steinkogler, F.J.; Nowotny, R. (Vienna Univ., Austria. Zentrales Inst. fuer Radiodiagnostik; Vienna Univ., Austria. II. Augenklinik). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4451 (INIS-mf—11046, pp 61) **Comparison of /sup 111/In-labelled polymer beads and /sup 99m/Tc-Sn-colloid as solid food and semi-solid food tracers for scintigraphic gastric emptying studies.** Maree, M.; Van Zandwyk, C.; Dormehl, I.; Pilloy, W. (Pretoria Univ., South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4452 **(INIS-mf—11046) South African Association of Physicists in Medicine and Biology: 27. Annual congress, 11-13 March 1987, Bloemfontein.** (South African Association of Physicists in Medicine and Biology, Pretoria). 1987. 73p. (In Afrikaans and English). (CONF-8703200—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW.

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

The twenty-seventh annual congress of the South African Association of Physicists in Medicine and Biology was held from 11-13 March 1987, in Bloemfontein. Papers delivered at the conference covered subjects like medical physics, radiotherapy, computed tomography, scintigraphy, radiation doses and dosimetry and radioisotopes in diagnosis.

4453 (INIS-mf—11046, pp 47) **Liver and spleen volume determination using SPECT.** Van Reenen, O.R. (4062220ZA). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4454 (INIS-mf—11046, pp 48) **Optimisation of multiformat photographic parameters for scintigraphy.** Mueller, C.; Wasserman, H.J. (Tygerberg Hospital, Bellville, South Africa. Dept. of Medical Physics). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4455 (INIS-mf—11046, pp 49) **Receiver operating characteristic analysis of single photon emission computed tomography parameters.** Wasserman, H.J.; Mueller, C.; Erlank, P. (Tygerberg Hospital, Bellville, South Africa. Dept. of Medical Physics). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4456 (INIS-mf—11046, pp 59) **Platelet modelling using /sup 111/In labelling.** Van Rensburg, A.J.; Loetter, M.G.; Heyns, A.duP.; Roodt, J.P.; Wessels, P.; Minnaar, P.C. (University of the Orange Free State, Bloemfontein, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4457 (INIS-mf—11046, pp 47) **Evaluation of four approaches to /sup 111/In planar image quantification.** Van Rensburg, A.J.; Loetter, M.G.; Minnaar, P.C. (University of the Orange Free State, Bloemfontein, South Africa. Dept. of Biophysics). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4458 (INIS-mf—11046, pp 62) **Establishing a technique to determine malabsorption using SeCHAT.** Hollestein, M.D.; Strydom, W.J.; Van Reenen, O.R.; Pilloy, W.; Van der Merwe, C.F. (Medical Univ. of Southern Africa, Pretoria, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4459 (INIS-mf—11046, pp 63) **Development of a triple counting correlator to assess the patency of blood vessels, using technetium radionuclide.** Siadat, L. (Rhodes Univ., Grahamstown, South Africa. Dept. of Physics and Electronics). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4460 (INIS-mf—11046, pp 64) **Mapping of electromechanical activity of the ventricles by phase analysis of radionuclide ventriculographic data.** Dormehl, I.C.; Hugo, N.; Marchee, M.; Van Vuuren, C.J.; Van Zandwijk, C.; Burow, R. (Pretoria Univ., South Africa; Veterans Administration Medical Centre, Oklahoma City, USA). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4461 (INIS-mf—11046, pp 58) **Cine image quality control.** Bruwer, M.P.; Bruwer, A. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4462 (INIS-mf—11046, pp 42) **Physics of electron intraoperative radiation therapy.** Lanzl, L.H.; Kao, M.; Rozenfeld, M.; Sabbas, A.; Pagnamenta, A. (Rush-Presbyterian-St. Luke's Medical Centre, Chicago, USA). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4463 (INIS-mf—11046, pp 56) **Evaluation of sodium iodide capsules for therapeutical uses in the treatment of thyroid carcinoma.** Gagiano, J.; Jansen, S.E.; Sweetlove, M.A.; Loetter, M.G.; Van Rensburg, A.J.; Minnaar, P.C.; Otto, A.C. (University of the Orange Free State, Bloemfontein, South Africa. Dept. of Biophysics; University of the Orange Free State, Bloemfontein, South Africa. Dept. of Nuclear Medicine). 1987. (In Afrikaans). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4464 (INIS-mf—11046, pp 65) **Treatment of a neuroblastoma in a child using I-131 MIBG.** Gagiano, J.; Van Aswegen, A.; Loetter, M.G.; Minnaar, P.C.; Smit, S.; Anderson, J.D.; Goedhals, L. (University of the Orange Free State, Bloemfontein, South Africa. Dept. of Biophysics; Department of Pediatrics, University of the Orange Free State, Bloemfontein, South Africa; 6531954ZA). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4465 (LUMEDW-MERL—1015-1-100-1986) **Studies of blood flow in human nasal mucosa with /sup 133/Xe washout technique and laser doppler flowmetry.** Olsson, P. (Lund Univ. (Sweden). Dept. of Oto-Rhino-Laryngology). 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753030/JAW.

The techniques were applied for studies of the influence of environmental temperature on the human nasal mucosa, for studies of mediators in nasal allergy and for studies of the sympathetic neurogenic control of blood flow in the nasal mucosa. The results show that the two techniques are complementary to one another. The /sup 133/Xe washout technique is useful for semiquantitative estimations of blood flow in the deeper parts of the mucosa, while the laser doppler technique is especially suited for continuous recordings of relative blood flow changes in the superficial part of the mucosa. Vascular changes may take part in body temperature regulation changes may take part in body temperature regulation as well as in conditioning of respiratory air. The results support the theories that changes in nasal mucosal blood flow are related to body temperature control, while conditioning of inspiratory air may be more dependent on mucosal blood content. The observed dissociation between changes in the resistance and the capacitance vessels also illustrates that these vascular segments are regulated in different ways. The present results indicate that leukotriene D/sub 4/ might contribute to an increased blood flow in the nasal mucosa and to blockage of the nasal airway in the acute allergic reaction. Vasomotion is demonstrated to be present in the nasal mucosa, and it appears to be partly dependent on sympathetic neurogenic activity. The development of the present techniques, means that vascular changes involved in normal nasal function and in nasal disease may be evaluated by a new approach.

4466 (NEI-DK—39, pp 115) **IC-99M rhenium sulphide colloid. A single step kit for lymphoscintigraphy.** Neves, M.; Patricio, L. (Sector de Radioisotopos, Laboratorio Nacional de Engenharia e Technologia Industrial, Sacavem PT). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4467 (NEI-DK—39, pp 110) **Automatic Tc-99M dispensing system for use in the preparation of Tc-99M radiopharmaceuticals.** Millar, A.M. (Radiopharmacy, Royal Infirmary, Edinburgh GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4468 (NEI-DK—39, pp 106-107) **Evaluation of an automated FDG synthesis system with a special emphasis on reduced radiation exposure as compared with a semiautomated system.** Tomiyoshi, K.; Inoue, T.; Sasaki, Y.; Ishihara, T.; Lagunas-Solar, M.; Iida, S. (Department of Nuclear Medicine, JP; Department of Radiology, Gunma University School of Medicine, Maebashi, JP; Japan Steel Works, Higashimuroran, JP; Crocker Nuclear Laboratory, University of California at Davis). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4469 (NEI-DK—39, pp 104-105) **Interaction of cytostatic agents (etoposide?) with radionuclide bone scanning.** Gansbeke, B. van; Vandermoten, G.; Quenon, M.; Schoutens, A. (Erasme Hospital, Free University Brussels, Brussels, BE). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4470 (NEI-DK—39, pp 101) **Use of joint scintigraphy to demonstrate the effect of intra-articular steroid therapy.** Palmer, M.; Schouls, J.C.; McCrae, F.C. (Dept. of Radiopharmacy, Bristol and Weston Health Authority, and Bone and Joint Imaging Unit, University Department of Rheumatology, Bristol Royal Infirmary). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4471 (NEI-DK—39, pp 100) **Strontium-89 for the palliation of pain in metastases in bone.** Bayly, R.J. (Amersham International PLC, Amersham, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4472 (NEI-DK—39, pp 81-82) **Radiopharmaceuticals for melanoma radionuclidic localization and therapy.** Shukla, S.K.; Cipriani, C.; Politano, G.; Manni, G.B.; Limouris, G. (Servizio di Medicina Nucleare, Ospedale S. Eugenio, Roma, IT; Dept. Nucl. Med., Natl. Bank of Greece, Athens, GR). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4473 (NEI-DK—39, pp 79-80) **Use of metimazol in the preparation of Tc-99m-labelled glyceryl trioleate: Studies of radiochemistry and biodistribution in rats and rabbits.** Lang, J. (Department of Nuclear Medicine, University Medical School, Szeged, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4474 (NEI-DK—39, pp 77-78) **Uptake mechanism of hida derivatives into isolated hepatocytes.** Stylli, C.G.; Theobald, A.E. (Chelsea Department of Pharmacy, Kings College London, KQC, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4475 (NEI-DK—39, pp 70-71) **Effect of radiolabelling on the immunological properties of polypeptide hormones.** Mohari, K.; Janoki, Gy.A.; Korosi, L. ("Frederic Joliot; Curie" National Research Institute for Radiobiology and Radiohygiene, Budapest, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4476 (NEI-DK—39, pp 68-69) **Monoclonal antibodies: Optimizing of labelling procedures by quality-control methods.** Steinsstrasser, A.; Schwarz, A.; Kuhlmann, L. (Hoechst, Frankfurt, DE). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4477 (NEI-DK—39, pp 67) **Indium 111 labeled glass spheres. A new solid food marker.** Jensen, M.; Lysgaard Madsen, J. (Niels Bohr Instituttet, Copenhagen, DK; Dept. of Clin. Physiol. Rigshospitalet, Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4478 (NEI-DK—39, pp 64) **Preparation and biodistribution of Tc-99m labelled hippuric acid.** Kecskes, F.; Szarvas, T. (Institute of Isotopes of the Hungarian Academy of Sciences, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4479 (NEI-DK—39, pp 60-61) **Synthesis and evaluation of new technetium-99m complexes.** Lever, S.Z.; Baidoo, K.E.; Kramer, A.V.; Burns, H.D.; Epps, L.A.; Scheffel, U.; Wagner, H.N. (The Johns Hopkins Medical Institutions, Baltimore, Maryland, US). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4480 (NEI-DK—39, pp 52-53) **Design of a hospital system for production of radiopharmaceuticals (quality assurance programme for a labelled biological product).** Lazarus, C.R. May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4481 (NEI-DK—39, pp 46) **Current trends in the requirements for safety and efficacy of new drugs.** Dige-Petersen, H.; Juul, P. (Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4482 (NEI-DK—39, pp 41-43) **Waste disposal.** Ennow, K. (National Institute of Radiation Hygiene, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4483 (NEI-DK—39, pp 35) **Efficacy studies of radioactive labelled monocloral antibodies for diagnosis and therapy.** Hvid Hansen, H. (Aarhus, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4484 (NEI-DK—39, pp 30-31) **Radiochemical purity determinations of labelled proteins.** Janoki, Gy. A. (Budapest, HU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4485 (NEI-DK—39, pp 28-29) **Specifications and quality control methods for labelled cells etc .** Danpure, H.J. (London, GB). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4486 (NEI-DK—39, pp 25-27) **Specifications and control methods for monoclonal antibodies.** Zeuthen, J. (Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4487 (NEI-DK—39, pp 22-23) **Models for safety testing of immunoreactive pharmaceuticals.** Svendsen, O.; Christensen, B.; Juul, P.; Rygaard, J. (Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4488 (NEI-DK—39, pp 11) **Newer Tc-99m radiopharmaceuticals.** Johannsen, B. (Berlin, DD). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4489 **(NEI-DK—39) Abstracts. Third European symposium on radiopharmacy and radiopharmaceuticals.** (Isotope-Pharmacy, Broenshoej (Denmark)). May 1987. vp. (CONF-8705177—Absts.). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW.

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

The Third European symposium on radiopharmacy and radiopharmaceuticals was held at Elsinore, Denmark. Individual presentations made at the symposium have been titled listed and indexed for the Energy Data Base.

4490 **(UCRL—97163) Analytical cytology applied to detection of prognostically important cytogenetic aberrations: Current status and future directions.** Gray, J.W.; Pinkel, D.; Trask, B.; van den Engh, G.; Pallavicini, M.; Fuscoe, J.; Mullikin, J.; van Dekken, H. (Lawrence Livermore National Lab., CA (USA)). 24 Jul 1987. Contract W-7405-ENG-48. 35p. (CONF-8704215—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000750/JAW.

From Conference on prediction of tumor treatment response; Banff, Canada (21 Apr 1987).

This paper discusses the application of analytical cytology to the detection of clinically important chromosome abnormalities in human tumors. Flow cytometric measurements of DNA distributions have revealed that many human tumors have abnormal (usually elevated) DNA contents and that the occurrence of DNA abnormality may be diagnostically or prognostically important. However, DNA indices (ratio of tumor DNA content to normal DNA content) provide little information about the specific chromosome(s) involved in the DNA content abnormality. Fluorescence in situ hybridization with chromosome specific probes is suggested as a technique to facilitate detection of specific chromosome aneuploidy in interphase and metaphase human tumor cells. Fluorescence hybridization to nuclei on slides allows enumeration of brightly fluorescent nuclear domains as an estimate of the number of copies of the chromosome type for which the hybridization probe is specific. Fluorescence hybridization can also be made to nuclei in suspension. The fluorescence intensity can then be measured flow cytometrically as an indication of the number of chromosomes in each nucleus carrying the DNA sequence homologous to the probe. In addition, quantitative image analysis may be used to explore the position of chromosomes in interphase nuclei and to look for changes in the order that may eventually permit detection of clinicaly important conditions. 55 refs., 8 figs., 1 tab.

4491 **Structure, dynamics, and thermodynamics of mismatched DNA oligonucleotide duplexes $d(CCCAGGG)_2$ and $d(CCCTGGG)_2$.** Arnold, F.H.; Wolk, S.; Cruz, P.; Tinoco, I. Jr. (Univ. of California, Berkeley). *Biochemistry;* **26**: No. 13, 4068-4075(30 Jun 1987). Contract AS03-82ER60090.

The structures and hydrogen exchange properties of the mismatched DNA oligonucleotide duplexes $d(CCCAGGG)_2$ and $d(CCCTGGG)_2$ have been studied by high-resolution nuclear magnetic resonance. Both the adenine-adenine and thymine-thymine mismatches are intercalated in the duplexes. The structures of these self-complementary duplexes are symmetric, with the two strands in equivalent positions. The evidence indicates that these mismatches are not stably hydrogen bonded. The mismatched bases in both duplexes are in the anti conformation. The mismatched thymine nucleotide in $d(CCCTGGG)_2$ is intercalated in the duplex with very little distortion of the bases or sugar-phosphate backbone. In contrast, the bases of the adenine-adenine mismatch in $d(CCCAGGG)_2$ must tilt and push apart to reduce the overlap of the amino groups. The thermodynamic data show that the T-T mismatch is less destabilizing than the A-A mismatch when flanked by C-G base pairs in this sequence, in contrast to their approximately equal stabilities when flanked by A-T base pairs in the sequence d(CAAAXAAAG-CTTTYTTTG) where X and Y = A, C, G, and T. Although the mechanism cannot be determined conclusively from the limited data obtained, exchange of the imino protons with solvent in these destabilized heteroduplexes appears to occur by a cooperative mechanism in which half the helix dissociates.

4492 **Prediction of radiation dosimetry in patients with thyroid cancer using a Gamma camera.** De Nardo, G.L.; Macey, D.J.; De Nardo, S.J.; Adams, D.A. (Univ. of California Davis Medical Center, Sacramento, CA). *Journal of Nuclear Medicine;* **26**: No. 5, 92(May 1985). (CONF-850611—).

From 32. annual meeting of the Society of Nuclear Medicine; Houston, TX, USA (2 Jun 1985).

Radioiodine in the thyroid or cervical metastases, and therefore radiation dosimetry, can be determined using a probe and phantom. This approach is not ideal for quantitating radioiodine and dosimetry for sites elsewhere in the body. The authors have studied the use of gamma camera methods in association with I-123 to predict the distribution of I-131 and its dosimetry in 3 patients with metastatic thyroid cancer. Images and urine were obtained after administration of tracer I-123 and treatment I-131 to each patient. The geometric mean of counts from anterior and posterior total body camera scans were used to determine body clearance. Organ or metastasis radioactvity and dosimetry were quantitated using planar images and SPECT. Uptake, clearance and dosimetry of structures, such as thyroid and nodular metastases in the lung, could be determined. In summary, a gamma camera method for improved quantitation of radioiodine distribution in the body has been explored. It provides quantitative pharmacokinetics which give better estimates of distribution of radiation dose. This information offers a less empirical approach to the treatment of thyroid cancer with I-131, and other cancers with radiolabeled antibodies.

4493 **Evidence of a saturable hepatic receptor for mouse monoclonal antibodies.** De Nardo, G.L.; De Nardo, S.J.; Peng, J.S.; O'Grady, L.F.; Mills, S.L.; Epstein, A.L.; Cardiff, R.D. (Univ. of California, Davis Medical Center, Sacramento, CA). *Journal of Nuclear Medicine;* **26**: No. 5, 67(May 1985). (CONF-850611—).

From 32. annual meeting of the Society of Nuclear Medicine; Houston, TX, USA (2 Jun 1985).

Monoclonal antibodies (MAb) can be labeled with I-123 at high specific activities, so that large amounts of radioactivity attached to small amounts of protein can be injected for radioimmunoimaging. This conserves antibody and decreases the opportunity for foreign protein reactions and target tissue binding site saturation. In order to assess the effects on pharmacokinetics and imaging, the authors administered microgram amounts of I-123-MAb (Lyn-1, IgG2a or B6.01, IgGl with and following 4-5 milligram preloading with MAb on separate occasions to 4 patients with a target tumor (B cell lymphoma) and 2 patients without a target tumor (breast cancer). Pharmacokinetics were observed in blood and urine by counting whole samples and HPLC fractions of these samples and in organs by serial imaging. Early blood clearance and urinary excretion were faster after injection of microgram amounts of MAb, but subsequently were comparable to those obtained after preload. This paper concludes that the amount of administered MAb dramatically influences the pharmacokinetics of mouse MAb. Saturable hepatic Fc receptors are probably the source of these observations. Reports of accelerated deiodination of MAb are related

to this phenomenon. Optimal imaging and treatment with MAb requires saturation of these hepatic receptors.

4494 Multicompartmental analysis of the kinetics of monoclonal antibody in cancer patients. Koizumi, K.; De Nardo, G.L.; De Nardo, S.J.; Peng, J.S.; Macey, D.J.; Hisada, K.; Tonami, N. (Univ. of California Davis Medical Center, Sacramento, CA). *Journal of Nuclear Medicine;* **26**: No. 5, 90(May 1985). (CONF-850611—).

From 32. annual meeting of the Society of Nuclear Medicine; Houston, TX, USA (2 Jun 1985).

Multicompartmental models were applied for analysis of kinetics of iodide labeled monoclonal antibody in cancer patients. About 14 compartments such as intravascular antibody pool, interstitial antibody pool, antibody processors, tumor antigen site, intravascular immune complex pool, intravascular iodide pool, and urine iodide pool were assumed. This model accounts for three molecular species, the antibody, and antibody complex, and free iodide or iodinated peptides. Patients were injected with I-123-Lym-1 IgG2a (anti B cell lymphoma antibody). After injection, blood and urine samples were sequentially collected. Plasma and urine were separated by HPLC into fractions of intact antibody, immune complex, and free iodide. This information was used for input data in the theoretical model. SAAM computer program was used to solve these compartmental models. Published linear rate constants for human serum albumin and human non-immune IgG were initially used. However, data calculated from the model differed from observed curves in several respects. The kinetics of mouse monoclonal antibody, a foreign protein in a patient, were significantly different from those reported for human IgG. When a nonlinear, saturable hepatic processor was incorporated in the model, calculated data fit the observed data better. This kinetic model provides a basis for calculating radiation doses for radioiodinated antibodies.

5507 Microbiology

REFER ALSO TO CITATION(S) 3206, 3213, 3258, 4440

4495 (DOE/EV/03941—75) Mechanisms of recombination and function of DNA in bacteria: Final report, April 1969 through November 30, 1985. Guild, W.R. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). Sep 1987. Contract AS05-76EV03941. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000352/JAW.

A brief overview of the authors research from 1969 to 1985 is presented. In the course of the work, we have developed a description of how the extracellular DNA binds to and enters the cell and how the cutting events on the surface and the stripping down to only one strand affects the biological end result. We also used these insights to develop a picture of the fate of the DNA after entry, both for transforming the chromosome or for creating a new replicon from either phage DNA or from plasmid DNA. In the course of doing this, we had first to develop a usable phage system, show transfection with its DNA, and find a novel "pseudotransduction" phenomenon. Later work, stimulated by the appearance of drug resistance in clinical isolates, led to the study of plasmids in pneumococcus and to showing that they transform the cells by processes similar to those used by phage DNA in transfection. These are two versions of the same process - creating a new replicon in the cell - and a full understanding of it has been helpful for others. A comparable understanding of the process in other species - Hemophilus in particular, remains to be established. 37 refs.

4496 (LA-UR—87-2215) First description of a variant of E. coli lacking superoxide dismutase activity yet able to grow efficiently on minimal, oxygenated medium. Fee, J.A.; Niederhoffer, E.C.; Naranjo, C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8706208—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013130/JAW.

From 6. international symposium on trace elements in man and animals (TEMA-6); Asilomar, CA, USA (2 Jun 1987).

A strain of E. coli has been obtained which is completely lacking in superoxide dismutase activity and is able to grow efficiently on glucose minimal media being sparged with pure oxygen. While its genotype is unknown, it appears to have arisen from mutation (s) which complements the absence of sodAB gene products without introducing superoxide dismutase activity. 1 ref., 2 figs.

5509 Pathology

REFER ALSO TO CITATION(S) 4425, 4465

4497 (INIS-mf—10757) Drug uptake (DAPI) of trypanosomes (T. brucei) and antitrypanosomal activity in vitro, in culture and in vivo studied by microscope fluorometry, chromatogram spectrophotometry and radiotracer techniques. Kratzer, R.D. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Fachbereich Biologie und Chemie). 21 Jul 1982. 218p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750180/JAW.

The present study had the following objectives: 1) Investigation of the specific binding and location of the diamidine DAPI within trypanosomes by fluorescence microscopy. 2) Development and standardization of a microscope fluorometry technique for measuring DAPI uptake of single trypanosomes. 3) Determination of the effect of incubation media, exposure time, and drug concentration on DAPI uptake of single trypanosomes. 4) Development of a technique applicable for quantitative fluorescence chemical analysis of DAPI uptake of trypanosomes. 5) Determination of drug uptake of trypanosomes using /sup 14/C labelled DAPI. 6) Comparison of the values obtained by the three methods.

4498 Radon Pollution Control Act of 1987. Hearing before the Subcommittee on Transportation, Tourism, and Hazardous Materials of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session, April 23, 1987. Washington, DC; Government Printing Office (1987). 122p.

Ten witnesses from the Environmental Protection Agency (EPA), state and local environmental agencies, teachers, health providers, and others testified on the risks and possible control measures of radon gas emissions in homes. Home tests are finding as many as 40% to have unacceptable levels, but EPA and other government agencies have waited for the media to alert the population. The witnesses were asked to suggest ways in which EPA can initiate assistance in this area in order to protect public health. EPA spokesmen reviewed their programs, including the Radon Action Program, which began operating in 1985. Material submitted for the record by EPA follows the testimony.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 4465

4499 Molecular basis of a microbe-mediated enhancement of symbiotic N_2-fixation. Unkefer, P.J.; Knight, T.J. (Los Alamos National Lab., NM). *Plant Physiology, Supplement;* **83**: No. 4, 118(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Improvement of biological nitrogen fixation represents a potential source of both increased food production and decreased dependence on costly chemical fertilizer. They report the results of an investigation of the molecular basis of a unique, microbial-mediated mechanism for increased growth and nitrogen fixation rates in alfalfa. Inoculation of alfalfa plants with both Rhizobium meliloti and Pseudomonas syringae pv tabaci provides increased growth and N_2-fixation rates of alfalfa. Tabaci produces tabtoxinine-β-lactam (TβL), an exocellular product and glutamine synthetase (GS) inhibitor. The association of this pathogen with nodulating alfalfa plants appears to alter the normal regulation of nitrogen fixation such that nitrogenase activity is stimulated and GS activity is inhibited. Studies of the soluble amino acids in these nodules and the activities of the ammonia assimilatory enzymes indicate alternative pathways of ammonia assimilation are being employed.

5520 Public Health

REFER ALSO TO CITATION(S) 3639, 4296, 4297, 4298, 4299, 4300, 4301, 4302, 4304, 4305, 4306, 4307, 4308

4500 **(PB—87-223202/XAB) Mutagenic monitoring of workplace and workers. Final report.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 25p. NTIS, PC A02/MF A01.

In efforts to safeguard employees against occupational exposure to potential genotoxic agents, various assay systems were devised and tested. Due to the fact that short-term genotoxicity studies can provide information regarding not only potential genetic hazards, but carcinogenic and teratogenic hazards as well, the establishment of these assay systems may be extremely important. Brief descriptions were offered of several studies in this area. These included: mutagenicity studies of air particles, volatile compounds and complex mixtures taken from workplace samples; development and validation of an in-situ assay system to detect airborne mutagenic agents in the workplace; the human cytogenetic assay system which has both sister chromatid exchange and chromosome aberration endpoints; the development of a bacterial forward mutation assay system using the new tester strain (SV-50) for the Salmonella arabinose resistant-forward mutation assay system; an evaluation of a urine mutagenesis assay system that has been used to determine whether workers were exposed to mutagenic agents.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 3247

4501 **(FRCEA-R—32) Radiation processing of fruits: application to strawberries and prunes.** Levillain, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Oct 1986. 114p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750234/JAW.

Extending the shelf-life of fresh fruit by means of low-dose irradiation (radurization) is not a new idea: experiments in that field started in the early sixties. These experiments have actually proved that, in some cases, irradiation can achieve shelf-life extension, either through a delay in ripening (bananas), or through rot inhibition (soft cherries, apricots, tomatoes, strawberries). Alas, they have also highlighted the intolerance showed by a number of fruits when radurized: irradiation is apt to have them ripen more rapidly (peaches, nectarines) or to soften them too much (pears, table grapes, oranges, apples, plums, grapefruit, melons, honeydew melons). Even in those cases where irradiation results in a benefit, this benefit varies depending on the variety of fruit involved, as can be seen from a deep survey of the irradiation of strawberries. Preservation of dehydrated fruit is a different matter. Prunes, for instance, would be contamined by molds, wasn't it for the addition of sorbic acid during the fabrication process. Ionization of prunes can allow producers to avoid the use of a chemical, and to keep the prunes at a greater degree of humidity.

4502 **(IAEA-R—4420-F) Tissue banking and clinical research on radiation and ethylene oxide sterilization of tissue grafts. Final report for the period June 1986-March 1987.** Pe Khin. (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 90p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700016/JAW.

The research carried out in Rangoon, Burma under the Agency supported project RC4420/RB have dealt with an elucidation of the radiation interaction(s) with biomolecules such as proteins, lipids, collagens, connective tissues present in the cleaned and freeze-dried non-viable tissue grafts. Radiation as a cool process furthermore effectively helps to destroy the microbial bioburden as the undesirable contaminants which may associate the tissue grafts. Radiation also concomitantly helps to suppress the tissue-specific immunogenicity. All these attributes of radiation induced effects have proved successful towards the development of a sterilization process. A series of non-viable tissue grafts, such as bone, nerve, fascia, dura, cartilage, chorion-amnion (as dressings in burn wounds) and tympanic membrane have been successfully attempted in Burma and many more possibilities seem to still remain unexplored. Radiation sterilization modality has proved as a blessing for the promotion of clinical surgical applications of tissue allografts in the corrective/reconstructive surgery on the disability cases due to diseases which accompany tissue losses. The investigator in Burma has reported on the case histories where freeze dried radiation sterilized tissue allografts have been successfully used in the osteogenic inductions (bone grafts); midear tympanoplasty; partial recovery of nerve sensation throught nerve allografts; rapid healing of high degree burn wounds through the use of amnion dressings. Besides, there have been a widespread surgical use of radiation sterilized dura and fascia as allografts. A national tissue banking facility has been established in Burma surrounding the processing and clinical utilization of tissue allografts which has involved over ten hospital centres throughout the country. 39 refs, 18 figs.

4503 **(INIS-XN—64) Second Agreement to extend the Agreement establishing the Asian Regional Cooperative Project on food irradiation.** (International Atomic Energy Agency, Vienna (Austria)). 11 Apr 1985. 2p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700044/JAW.

Treaty Series 1985 No. 13.

This Agreement extends for 3 years as from 28 August 1984 the original Agreement established within the framework of the Regional Cooperative Agreement on R and D related to Nuclear Science and Technology under the aegis of IAEA. Australia ratified it on 11 April 1985. (NEA).

4504 **(INIS-XN—70) Order of 12 August 1986 on treatment by ionizing radiation of material and objects in contact with foods and beverages.** (International Atomic Energy Agency, Vienna (Austria)). 20 Aug 1986. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700050/JAW.

Published in Journal Officiel de la Republique francaise.

This Order applies to packaging material and articles in contact with foods and beverages, when they are treated by cobalt 60 or caesium 137 gamma rays, accelerated electrons of the energy lower than or equal to 10 MeV and X rays of the energy lower than or equal to 10 MeV. (NEA).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 5129

4505 **(AD-A—183252/6/XAB) Rat phantom depth dose studies in electron, x-ray, gamma-ray, and reactor-radiation fields. Technical report.** Dooley, M.; Eagleson, D.M.; Zeman, G.H. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1986. 18p. (AFFRI-TR—86-5). NTIS, PC A02/MF A01.

High-energy electrons, bremsstrahlung, and mixed neutron/gamma radiation fields are sometimes used in radiobiological experiments employing rats. This report describes the methods and results of a study of depth dose distribution in an acrylic rat phantom for each of these fields. Activation foils and thermoluminescent dosimeters were used to make the measurements.

4506 **(AD-A—183481/1/XAB) Effect of ionizing radiation on prostaglandin and gastric secretion in rhesus monkeys.** Dubois, A.; Dorval, E.D.; Steel, L.; Fiala, N.P.; Conklin, J.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 6p. (AFRRI-SR—87-10). NTIS, PC A02/MF A01.

Pub. in Radiation Research, Vol. 110, 289-293(1987).

Early radiation toxicity is characterized by nausea and vomiting. The authors have previously shown that gastric emptying, gastric motility, and gastric secretion were suppressed after total-body exposure to irradiation. In this studies, the authors evaluated the relation between vomiting and gastric function in nine rhesus

monkeys and explored the possible role of prostaglandins (PG) in these phenomena. The concentration of PG in plasma and gastric juice was determined using a standard radioimmunoassay, and gastric-acid output was measured concurrently using a marker dilution technique. The animals were studied in the basal state and after total-body exposure to 800 cGy ^{60}Co delivered at a rate of 500 cGy/min. Acid output was abolished from 40 min to 2 h after irradiation but had returned to preirradiation levels 2 days later. Plasma PGE2 and PGI2 (as measured by 6-keto-PGE determination) were not significantly modified by irradiation. In contrast, irradiation produced an immediate significant increase ($P<0.05$) in gastric-juice concentration of PGE2 and PGI2; both had returned to basal levels 2 days later. Thus, an increase in gastric-juice concentration of both PGE2 and PGI2 is associated with the radiation-induced suppression of acid output.

4507 (AD-A—183483/7/XAB) Effects of ionizing radiation on hippocampal excitability. Pellmar, T.C.; Tolliver, J.M. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 6p. (AFRRI-SR—87-17). NTIS, PC A02/MF A01.

Pub. in Brain Slices: Fundamentals, Applications and Implications Conference, 152-156(1986).

Ionizing radiation causes striking changes in hippocampal activity in vivo. Changes in neuronal firing patterns and spiking activity in electroencephalographic recordings appear at doses as low as 4 Gy. Accompanying exposure to ionizing radiation is a breakdown in blood brain barrier and a decrease in cerebral blood flow. In an effort to define the mechanisms of radiation damage to neuronal excitability, without these complicating factors, the effects of radiation on neuronal activity in hippocampal slices were investigated. Damage is likely to result from generation of free radicals. Since peroxide mixed with iron produces hydroxyl free radicals through the Fenton reaction, peroxidative damage was evaluated on hippocampal slices for comparison.

4508 (AD-A—183500/8/XAB) 16,16-Dimethyl prostaglandin E2 increases survival in mice following irradiation. Walden, T.L.; Patchen, M.; Snyder, S.L. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 10p. (AFRRI-SR—87-21). NTIS, PC A02/MF A01.

Pub. in Radiation Research, Vol. 109, 440-448(1987).

16,16-Dimethyl prostaglandin E2(DiPGE2), a stable analog of PGE2, increases the LD 50/30 survival in CD2F1 male mice when given prior to ionizing radiation. Subcutaneous administration of 40 microgram of DiPGE2 30 min prior to ^{60}Co gamma irradiation extends the LD 50/30 from 9.39 Gy in the control animals to 16.14 Gy in DiPGE2 treated, with a dose-reduction factor of 1.72p95% confidence limits: 1.62, 1.82. The degree of protection is dependent on both the time of administration and the dose of the prostaglandin. Ten micrograms administered 5 min prior to receiving a lethal dose of 10 Gy provides 90% survival but only 10% survival if administered 30 min prior to irradiation. Experiments to determine the in vivo concentration of DiPGE2 in organs post injection show increased levels over time, but these are not correlated with protection. At 30 min after injection, as much as 80% of the DiPGE2 present in the spleen and plasma is unmetabolized. These results suggest that the protection results from the physiologic action of DiPGE2 rather than direct in vivo detoxification of radicals.

4509 (AD-A—183581/8/XAB) Dose and time relationships of the radioprotector WR-2721 on locomotor activity in mice. Landauer, M.R.; Davis, H.D.; Dominitz, J.A.; Weiss, J.F. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 5p. (AFRRI-SR—87-14). NTIS, PC A02/MF A01.

Pub. in Pharmacology Biochemistry and Behavior, Vol. 27, 573-576(1987).

The effects of the radioprotector S-2-(3-aminopropylamino)ethylphosphorothioic acid (WR-2721) on locomotor activity were evaluated in CD2F1 male mice. Separate groups of animals (N=10/group) received an IP injection of vehicle, 25, 50, 100, 200, or 400 mg/kg of WR-2721 immediately before testing. Horizontal and vertical activity were measured using a Digiscan automated animal-activity monitor. The latency to onset and duration of action of each dose of the radioprotector were recorded. For both behavioral measures, a significant reduction was observed in activity at doses of 200 and 400 mg/kg. A dose of 200 mg/kg had a 12- to 14-min latency to onset and significantly reduced behavioral activity for 3 hr. Mice injected with 400 mg/kg exhibited locomotor deficits within 8-10 min and were affected for up to 9 hr. The ED50 for horizontal and vertical activities at 1 hr postinjection were determined to be 271 and 105 mg/kg, respectively. The results demonstrate that significant reductions in locomotor activity are exhibited at doses of 200mg/kg or more and that vertical activity was more sensitive to the disruptive effects of WR-2721 than was horizontal activity.

4510 (AD-A—183604/8/XAB) Effects of subdiaphragmatic vagotomy on the acquisition of a radiation-induced conditioned taste aversion. Hunt, W.A.; Rabin, B.M.; Lee, J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 4p. (AFRRI-SR—87-12). NTIS, PC A02/MF A01.

Pub. in Neurotoxicology and Teratology, Vol. 9, No. 1, 75-77(1987).

The effect of subdiaphragmatic vagotomy on the acquisition of a radiation-induced taste aversion was examined to assess the importance of the vagus nerve in transmitting information on the peripheral toxicity of radiation to the brain. Vagotomy had no effect on taste aversion learning, consistent with reports using other toxins. The data support the involvement of a blood-borne factor in the acquisition of taste aversion induced by ionizing radiation.

4511 (AERE-R—12227) Retention of calcium and strontium in late adult life. Newton, D.; Johnson, P.; Harrison, G.E.; Rundo, J. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jun 1987. 19p. H.M. Stationery Office, London, price Pound 4.00.

Data are presented on the retention of calcium and strontium in a healthy male volunteer who, at various ages between 53 and 80 years, recieved one or more intakes of ^{46}Ca, ^{47}Ca and ^{85}Sr. Some of these data are previously unreported; in other cases the reported data have been re-analysed on a consistent basis to permit legitimate comparisons. Collectively the results lend support to an important working postulate in the ICRP's model of alkaline earth metabolism in adult man, viz. that, for purposes of radiological protection, whole-body retention can be regarded as independent of age at intake.

4512 (BNL—40090) Risk equivalent of exposure versus dose of radiation. Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 40p. (CONF-8611189—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87013317/JAW.

From Meeting on radiation effects; Washington, DC, USA (19 Nov 1986).

This report describes a risk analysis study of low-dose irradiation and the resulting biological effects on a cell. The author describes fundamental differences between the effects of high-level exposure (HLE) and low-level exposure (LLE). He stresses that the concept of absorbed dose to an organ is not a dose but a level of effect produced by a particular number of particles. He discusses the confusion between a linear-proportional representation of dose limits and a threshold-curvilinear representation, suggesting that a LLE is a composite of both systems. (TEM)

4513 (BNL—40247) ALARA and de minimis concepts in regulation of personnel exposure. Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-8709104—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014922/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

The ALARA process should not be limited by a de minimis level on either collective or individual dose, but should be limited or defined by an acceptable discount-rate on future costs and effects, and a monetary value for detriment, to be used in cost-effectiveness or cost-benefit calculations at dose levels well below the regulatory limits. This approach would provide the desired benefit of simplifying the decision process, it makes it more cost effective,

and would avoid the inconsistencies of limits on only one of the four parameters of importance in the optimization process. These are average individual effective dose equivalent rate, number of individuals to be included in the summation, years of exposure, and costs, which include costs of analysis to reduce the exposure. This approach emphasizes that these doses to an individual may not be considered trivial by society when given to a very large population, especially if they could easily be avoided. 32 refs., 2 tabs.

4514 **(CEA-R—5386) Early changes of cortical blood flow, brain temperature and electrical activity after whole-body irradiation of the monkey (Macaca fascicularis) (dose range: 3-20 Gy).** Court, L.; Gourmelon, P.; Mestries, J.C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). Feb 1987. 79p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753227/JAW.

A polyparametric investigation was carried out on 31 monkeys chronically wearing bioinstrumentation allowing to get and process simultaneously local brain blood flow, cerebral temperature, and energies in various frequency bands of the brain electrical activity. This method, which supplied data during several consecutive days, made it possible to study both the biological rhythms at the level of the various parameters, and their fast variations. The effects of whole-body gamma or neutron-gamma irradiation were studied in the 3-20 Gy dose range. Immediate changes after exposure demonstrated different radiosensitivities at the level of the rhythms of the various parameters, and/or their recovery, as well as dose-effect relationships.

4515 (CONF-841142—, pp 73-81) **Comparative plant uptake of plutonium-239 added to soil in the oxide vs. the nitrate form.** Cline, J.F.; Schreckhise, R.G. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The uptake of ^{239}Pu, added to soil in the oxide vs. the nitrate form, by pea and barley plants was compared during three consecutive growing seasons. The ^{239}Pu-amended soil was contained in 1-m-long by 13.2-cm-diameter polyvinyl chloride containers maintained in an outdoor enclosure to expose the soil columns and growing plants to realistic environmental conditions. The ^{239}Pu oxide particles, which had an activity median stokes diameter of 6.1 μm, were added to the soil by pipetting a special liquid suspension directly to the soil surface of the nearly filled containers. A 10-cm-thick layer of uncontaminated soil was placed over the surface of the amended soil as a safety precaution. The ^{239}Pu nitrate containers were prepared in the same manner. The uptake of the nitrate form of ^{239}Pu was 10 to 20 times as great as the oxide form for both peas and barley. The uptake of both chemical forms decreased by about a factor of 10 during the three growing seasons, and the levels in the seeds were consistently less than the levels in the others above ground plant parts for both plant species. 23 references, 1 figure, 2 tables.

4516 (CONF-841142—, pp 83-95) **Factors affecting absorption, transport, and form of plutonium in plants.** Garland, T.R.; Cataldo, D.A.; McFadden, K.M.; Wildung, R.E. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

The absorption of Pu by plants was related primarily to differences in soil properties and to the presence of natural and synthetic organic ligands that partially stabilized Pu against hydrolysis in soil. Plant/soil concentration ratios (CR) were also affected by a series of secondary processes related to plant growth rate and production of biomass. The valence state of Pu added to soil did not affect CR values due to reduction of Pu(VI) to Pu(IV). The Pu was transported in plant xylem fluid to aerial leaf tissue as Pu(IV) organic acid complexes. Variables affecting the chemical form of Pu in plants after uptake included plant age, plant species, and the presence of nutrient elements (especially Fe, Zn, and Cu) that competed for reaction sites on plant organic ligands. Test plants used were alfalfa, peas, soybeans, squash, and bushbeans.

4517 (CONF-841142—, pp 97-107) **Neptunium behavior in plants: absorption, distribution, and fate.** Cataldo, D.A.; Garland, T.R.; Wildung, R.E. Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Uptake by soybean seedlings of Np(V) from solutions containing 7×10^{-7} to 473^{+} g Np/mL is proportional to concentration, exhibiting some saturation in root absorption at higher concentrations. Soil-plant concentration ratios (CR) for bushbeans, measured over the range of 5.2×10^{-7} to 4.1 μg Np/g soil, are ~2 at soil concentrations below 4×10^{-4} μg/g and increase to 12 at higher soil levels. The CR values determined for soybeans, bushbeans, barley, and alfalfa range from 0.5 to 4 at a soil concentration of 2.6×10^{76} μg/g; seed concentrations in bushbeans and wheat are a factor of 10 lower than vegetative tissues. Fractionation of plant tissues indicates that neptunium is substantially more soluble than plutonium, especially in seeds, with ~50% of the soluble neptunium in roots and leaves associated with plant ligands of <5000 molecular weight (MW). 12 references, 5 figures, 1 table.

4518 (CONF-841142—, pp 391-427) **Comparative concentrations of ^{137}Cs, ^{90}Sr, /sup 239,240/Pu, and ^{241}Am in tissues of fish from the Marshall Islands and calculated dose commitments from their consumption.** Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Robison, W.L. (Lawrence Livermore National Lab., CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE86008713/JAW.

From Symposium on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1984).

Body burdens of ^{90}Sr, ^{137}Cs, and the transuranics in bottom-feeding fish from Marshall Island atolls are derived, in part, from the quantities of the radionuclides irreversibly fixed to ingested carbonate material. Radionuclide concentration factors for different species of fish are characterized by relating tissue concentrations to those in filtered seawater. For bottom-feeding fish, the values are lower at the lesser contaminated atolls than those values determined for the same species at the more contaminated atolls. These fish have the ability to lower their gut pH during feeding. When this occurs, there is a dissolution of a fraction of the ingested calcium carbonate containing radionuclides that were fixed or fused internally to the material during nuclear testing. Fractions of the radionuclides released during solution in carbonate matrix are available for passage across the gut wall. Amounts released to solution in the gut are proportional to the levels of contamination at the different atolls. Concentration factors for higher trophic level species, which do not rely on sediments or coral for their source of food, show no such trends between differentially contaminated atolls. A two-source model used to compute the internal concentrations is described. Americium-241 seems to be more biologically available than /sup 239,240/Pu to higher trophic level species from the lagoons, whereas at lower trophic levels the opposite seems to be the case. Cesium-137 is now the largest contributor of the small radiological dose to man from the marine fish pathway, with the transuranics contributing from 2 to 30% of the total dose. 22 references, 1 figure, 19 tables.

4519 **(CONF-871020—2) Performance characteristics of neutron personnel dosemeters used in the Oak Ridge intercomparison studies.** Swaja, R.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014952/JAW.

From 6. symposium on neutron dosimetry; Neuherberg, F.R. Germany (12 Oct 1987).

To provide an opportunity for dosimetrists to test and calibrate their neutron personnel monitoring systems, the staff of the Dosimetry Applications Research Facility at the Oak Ridge National Laboratory (ORNL) has conducted personnel dosimetry intercomparison studies (PDIS) periodically since 1974. During these studies, neutron dosemeters are mailed to ORNL, exposed to low-level (less than 15 mSv) dose equivalents in a variety of mixed-radiation fields produced using the Health Physics Research Reactor (HPRR), and then returned to the participants for evaluation. Beginning with the Seventh PDIS in 1981, interest and participation in the Oak Ridge intercomparisons increased significantly and con-

sistent and documented methods for determining reference neutron dose equivalents for the HPRR were introduced. This paper presents a summary and analysis of about 3450 neutron dose equivalent measurements reported for PDIS 7 through 12 (1981-1986) with particular emphasis on low dose equivalent sensitivity, accuracy and precision, and performance relative to accreditation standards for the basic types of personnel dosimetry systems. (16 refs., 3 tabs.

4520 (INIS-mf—11046, pp 57) **Repair of gamma-radiation induced DNA damage in human peripheral lymphocytes: influence of 3-aminobenzamide.** Louw, W.K.A.; Van Rensburg, E.J.; Engelbrecht, R.I.; Izatt, H. (Pretoria Univ., South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4521 (INIS-mf—11046, pp 68) **OER and RBE for /sup 125/I and /sup 192/Ir at low dose rate on mammalian cells.** Hering, E.R.; Sealy, G.R.H.; Dowman, P. (Groote Schuur Hospital, Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4522 (INIS-mf—11046, pp 69) **Simultaneous and sequential interaction studies in neutron/gamma radiation fields.** Slabbert, J.P.; Jones, H.L.; Hough, J.H. (Council for Scientific and Industrial Research, Pretoria, South Africa. National Accelerator Centre). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4523 (INIS-mf—11046, pp 70) **Effect of 10Gy x-irradiation on ATP and glutathione in rodent tumors.** Szeinfeld, D.; Wynchank, S.; Blekkenhorst, G. (South African Medical Research Council, Cape Town; Groote Schuur Hospital, Cape Town, South Africa. Dept. of Radiotherapy). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4524 (INIS-mf—11046, pp 51) **Is the ten day rule still applicable?.** Van der Merwe, E.J. (Tygerberg Hospital, Bellville, South Africa). 1987. (In Afrikaans). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

4525 **(ISH—108) Assessment of radiation dose commitment in Europe due to the Chernobyl accident. Report on a WHO meeting, Bilthoven, 25-27 June 1986.** Wirth, E.; Egmond, N.D. van; Suess, M.J. (eds.). (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1987. 61p. (CONF-8606351—Summ.). Bundesgesundheitsamt, Neuherberg, Germany, F.R. Inst. fuer Strahlenhygiene.

From WHO meeting: assessment of radiation dose commitment in Europe due to the Chernobyl accident; Bilthovan, Netherlands (25 Jun 1986).

The meeting in Bilthoven was held to make a preliminary assessment of the radiation dose commitment in Europe and to compare meteorological simulation models. Today, one year after the accident at Chernobyl, a much better data base and more precise dose estimates are available. Yet we are still publishing this report as we feel that it is of interest to compare the first dose assessments (external irradiation, inhalation, ingestion) with later ones to get an idea of the reliability of early dose predictions. Consequently the figures in the report reflect the state of knowledge in June 1986. Since last summer data from many extensive measuring programmes have been available to compile maps showing the local dose rates for most European countries. These now may be compared with the early meteorological calculations. This comparison should help scientists to improve their prognostic statements after widespread accidental releases.

4526 **(JYFL-RR—1/86) Late radiation damage in bone, bone marrow and brain vasculature, with particular emphasis upon fractionation models.** Pitkaenen, M. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Apr 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753039/JAW.

X-ray induced changes in rat and human bone and bone marrow vasculature and in rat brain vasculature were measured as a function of time after irradiation and absorbed dose. The absorbed dose in the organ varied from 5 to 25 Gy for single dose irradiations and from 19 to 58 Gy for fractionated irradiations.The number of fractions varied from 3 to 10 for the rats and from 12 to 25 for the human. Blood flow changes were measured using an "1"2"5I antipyrine or "8"6RbCl extraction technique. The red blood cell (RBC) volume was examined by "5"1Cr labelled red cells. Different fractionation models have been compared. Radiation induced reduction of bone and bone marrow blood flow were both time and dose dependent. Reduced blood flow 3 months after irradiation would seem to be an important factor in the subsequent atrophy of bones. With a single dose of 10 Gy the bone marrow blood flow returned to the control level by 7 months after irradiation. In the irradiated bone the RBC volume was about same as that in the control side but in bone marrow the reduction was from 32 to 59%. The dose levels predicted by the nominal standard dose (NSD) formula produced about the same damage to the rat femur seven months after irradiation when the extraction of "8"6Rb chloride and the dry weight were concerned as the end points. However, the results suggest that the NSB formula underestimates the late radiation damage in bone marrow when a small number of large fractions are used. In the irradiated brains of the rats the blood flow was on average 20.4% higher compared to that in the control group. There was no significant difference in brain blood flow between different fractionation schemes. The value of 0.42 for the exponent of N corresponds to the average value for central nervous system tolerance in the literature. The model used may be sufficiently accurate for clinical work provided the treatment schemes used do not depart too radically from standard practice.

4527 **(KFK—4215) Isolation of a XP-A cell clone with intermediate UV sensitivity following transfection with genomic mouse DNA. Isolation and characterization of transfected sequences.** Blum, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Bio- und Geowissenschaften). Apr 1987. 157p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750016/JAW.

The work presented here describes an attempt to restore repair proficiency in xp cells of the most UV sensitive complementation group A by DNA mediated gene transfer. The transfection conditions employed for the cell line used here (XP12Rotk/sup -/1) have been optimized.

4528 **(LBL—22417) The maximum likelihood estimator method of image reconstruction: Its fundamental characteristics and their origin.** Llacer, J.; Veklerov, E. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 16p. (CONF-8706213—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000462/JAW.

From 10. information processing in medical imaging international conference; Utrecht, Netherlands (22 Jun 1987).

We review our recent work characterizing the image reconstruction properties of the MLE algorithm. We studied its convergence properties and confirmed the onset of image deterioration, which is a function of the number of counts in the source. By mod-

ulating the weight given to projection tubes with high numbers of counts with respect to those with low numbers of counts in the reconstruction process, we have confirmed that image deterioration is due to an attempt by the algorithm to match projection data tubes with high numbers of counts too closely to the iterative image projections. We developed a stopping rule for the algorithm that tests the hypothesis that a reconstructed image could have given the initial projection data in a manner consistent with the underlying assumption of Poisson distributed variables. The rule was applied to two mathematically generated phantoms with success and to a third phantom with exact (no statistical fluctuations) projection data. We conclude that the behavior of the target functions whose extrema are sought in iterative schemes is more important in the early stages of the reconstruction than in the later stages, when the extrema are being approached but with the Poisson nature of the measurement. 11 refs., 14 figs.

4529 (NEI-DK—39, pp 102-103) **Protective efficacy of the s-anisyl formamidino-4(N-4ethyl isothioamide) morpholine dihydrocloride in rats irradiated with three graded doses of (9000r) x-irradiation.** Thakur, D.K. (Head Department of Biology, Seth G.R. Chamria College, Fatehpur-Shekhawati, Sikar-Raj, IN). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4530 (NEI-DK—39, pp 88) **Tc-99m aerosols for lung ventilation. A study of some physioco-chemical and operational properties.** Vinberg, N.; Ennow, K. (The Isotope-Pharmacy, Copenhagen, DK; The Institute of Radiation Hygiene, Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4531 (NEI-DK—39, pp 85-86) **In vitro kinetics of HM-PAO d,l. in human blood.** Friberg, H.; Andersen, A.; Lassen, N.A.; Kristensen, K.; Neirinckx, R.D. (Department of Neurology, Rigshospitalet, Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4532 (NEI-DK—39, pp 84) **Relationships between protein binding of tumoraffine radioactive metal-citrate-complexes and the radionuclide tumor accumulation.** Schomacker, K.; Mocker, D.; Beyer, G.J.; Munze, R.; Franke, W.G. (Central Institute for Nuclear Research Rossendorf, DD; Clinic for Nuclear Medicine of the Medical Academy "Carl Gustav Carus" Dresden, DD). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4533 (NEI-DK—39, pp 76) **Biodistribution of individual components of MDP separated by liquid chromatography.** Handeland, Aa.; Heggli, D.-E. (The Norwegian Radiumhospital, Oslo, NO; Norsk Radiofarmasi A/S, NO). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4534 (NEI-DK—39, pp 73) **Regional myocardial distribution of RP-30 in animal models of myocardial ischemia and reperfusion.** Mousa, S.A.; Cooney, J.M.; Williams, S.J. (E.I. du Pont de Nemours, and Co., No. Billerica, MA, US). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4535 (NEI-DK—39, pp 72) **Scintigraphy and distribution study of I-131 labelled antifibrinogen antibody and its F/AB//sub 2/ fragment in tumour bearing rats.** Svihovcova, P.; Brousil, J.; Vitek, F.; Dienstbier, Z. (Department of Biophysics and Nuclear Medicine, Faculty of Medicine, Prague 2, CS). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4536 (NEI-DK—39, pp 62-63) **Tc-99m labelled new pyrrolidinyl diaminodithiol derivatives. Biodistribution studies.** Chiotellis, E.; Varvarigou, A.D.; Papadopoulos, M.S. (Radiopharmaceuticals Lab. National Research Center of Physical Sciences "Demokritos", GR). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4537 (NEI-DK—39, pp 34) **Safety aspects of human use of labelled cells.** Dige-Petersen, H. (Copenhagen, DK). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4538 (NEI-DK—39, pp 24) **Mouse tumor model for screening radiotracer uptake into primary neoplasms and metastatic disease.** Wiebe, L.I.; Kanclerz, A.; Tooth, P.; Luu, K.; Knaus, E.E. (Edmonton, CA). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4539 (NRPB-GS—7) **Committed dose equivalent to selected organs and committed effective dose equivalent from intakes of radionuclides.** Kendall, G.M.; Kennedy, B.W.; Greenhalgh, J.R.; Adams, N.; Fell, T.P. (National Radiological Protection Board, Chilton (UK)). Aug 1987. 114p. H.M. Stationery Office, London, price Pound 7.00.

This report lists dose quantities per unit intake by ingestion or by inhalation of 1 μm AMAD particles of 322 radionuclides. The dose quantities given are committed effective dose equivalent and committed dose equivalents to certain important organs including the organ receiving the highest dose. Doses are listed for adults, children aged 10 years and infants aged 1 year. The period over which doses are accumulated is 50 years for adults and to age 70 for infants and children. The data presented here are a summary of the information held on the RAPID data base. The report also describes the changes which have been made to the data base since it was described in report NRPB-R162 and outlines the way in which future revisions of dose per unit intake will be implemented. There are appendices which given some dose quantities for fetuses and for infants aged six months. Finally, intercomparisons of the RAPID data base with other compendiums of dose values are discussed.

4540 (PNL-SA—14723) **Radiation-induced carcinogenesis in dogs.** Frazier, M.E.; Seed, T.M.; Scott, L.L.; Stiegler, G.L. (Pacific Northwest Lab., Richland, WA (USA); Argonne National Lab., IL (USA)). Sep 1987. Contract AC06-76RL01830. 7p. (CONF-870701—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000101/JAW.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

Lung tumors and leukemic cells obtained from studies of lifespan dose-effect relationships in beagles exposed either to plutonium by inhalation or to external whole-body gamma radiation are being used to examine the role of oncogenes in radiation-induced carcinogenesis.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 4426

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 2819, 4069, 4283, 4291, 4293, 4294, 4319, 4321, 4322, 4344, 4345, 4346, 4347, 4348, 4349, 4351, 4353, 4357, 4402, 4443, 5134

4541 (DOE/EV/04959—9) Physico-chemical methods for the study of polycyclic aromatic hydrocarbon carcinogen-DNA interactions: Progress report, March 1, 1985 to August 31, 1987. Geacintov, N.E. (New York Univ., NY (USA)). 31 Aug 1987. Contract AC02-78EV04959. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000899/JAW.

Linear dichroism was used to study the conformations of polycyclic aromatic carcinogen-DNA adducts and non-covalent complexes, as well as for following the kinetics of the interactions of the highly reactive metabolites of these carcinogens with DNA in aqueous solutions. We have also begun to investigate the fluorescence properties of carcinogen-DNA adducts. The results of these studies on the base-sequence selectivities and base-sequence specificities of the interactions of polycyclic aromatic hydrocarbon diol epoxides with nucleic acids, have stimulated the developments of models of reaction mechanisms and biological activity/carcinogen-DNA adduct structure relationships. 18 refs., 4 figs., 1 tab.

4542 (GAO/NSIAD—86-205BR) Hazardous waste: Selected aspects of cleanup plan for Rocky Mountain Arsenal. (General Accounting Office, Washington, DC (USA)). 1986. 16p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Army uses Rocky Mountain Arsenal for the manufacture and assembly of chemical intermediate and toxic end-item products, incendiary munitions, and chemical warfare agents. The problem of contaminants migrating from the Arsenal into offsite groundwater has been recognized since 1954. Army initiated a remedial investigation and a feasibility study to select an appropriate remedy that will adequately protect the public health and welfare and the environment. Costs to clean up the Arsenal are estimated at $964 million to $4.2 billion.

4543 (GAO/RCED—86-125) Pesticides: EPA's formidable task to assess and regulate their risks. (General Accounting Office, Washington, DC (USA)). 1986. 138p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

Most of the 50,000 pesticide products registered for use today have not been fully tested and evaluated in accordance with current testing requirements. These tests are required to determine a pesticide's potential for causing chronic effects in humans. At its current pace, EPA's reassessment and reregistration efforts will extend into the 21st century due to the magnitude and complexity of the tasks involved. Until EPA completes this effort, the health and environmental risks and benefits associated with older pesticides and their uses will not be fully known. EPA's review has been affected by data not being readily available and the competing demands on EPA resources. EPA's reregistration effort is further complicated by the need for an efficient mechanism to obtain test data on the effects of some inert ingredients and by the apparent legal inconsistencies that prohibit the use of a cancer-causing pesticide while, under other circumstances, allowing the use of the same pesticide.

4544 (GAO/RCED—86-177BR) Air quality standards: Role of the Health Effects Institute in conducting research. (General Accounting Office, Washington, DC (USA)). 1986. 44p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877.

The Health Effects Institute is an independently governed organization, jointly funded by the public and private sectors to conduct scientific research, for regulatory purposes, concerning the health effects on humans of motor vehicle emissions. The consensus is that research HEI is performing is credible and of high quality. GAO believes that future funding should still be considered and that more open dialogue between the Environmental Protection Agency and HEI could help ensure that an increasing number of mutually agreed upon relevant research projects are undertaken.

4545 (JEN—592) Integral parametrization of the kinetics of crosslink production in plasmid DNA as a function of 8-methoxypsoralen concentration. Vidania, R de; Paramio, J.M.; Bauluz, C. (Junta de Energia Nuclear, Madrid (Spain)). 1986. 15p. (In English and Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700061/JAW.

The results of crosslink production in pBR322 DNA along a wide range of 8-methoxypsoralen (8 MOP) concentration are presented. Experimental data were obtained as DNA renaturation percentages, from the shift in hyperchromicity after a temperature-dependent denaturation-renaturation process. The experimental results showed a three-stage profile when represented as a function of the natural logarithm of 8-MOP concentration. An integral parametrization which allows a simultaneous fit of the three observed stages is presented here. The theoretical values of crosslink production determined from the fit are useful to assess the genotoxicity of psoralen-induced crosslinks in plasmid DNA.

4546 (KFK-PEF—15) Structural studies of the cell walls in wood of diseased conifers to assess wood quality. Fengel, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Feb 1987. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750008/JAW.

The wood of various areas across the trunk from six spruce and six fir trees with varying degrees of needle loss originating from a single site were studied by electron microscopic and chemical methods. Growth anomalies within the annual rings were observed in the SEM. Observations with the TEM and the UV microscope showed no changes in the compound middle lamella, the cell corners or in the cell wall structure. The study of the acetone and the dioxane extracts did not result in changes of the soluble cell wall components related to the damage class; neither were variations in the molecular structure of the soluble lignin found by infrared spectroscopy. With 20 figs., 13 refs.

4547 (NEI-DK—39, pp 74) **Influence of aluminium on biodistribution of Tc-99m-diphosphonates in rats.** Jovanovic, M.V.; Jovanovic, M.S.; Maksin, T.N. (The Boris Kidric Institute of Nuclear Science, Belgrade, YU). May 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780028/JAW. (CONF-8705177—Absts.).

From 3. European symposium on radiopharmacy and radiopharmaceuticals; Elsinore, Denmark (1 May 1987).

4548 (NP—8750150) Damage to forests and forest structures - an analysis of the Schleswig-Holstein region. Runkel, M.; Kenneweg, H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Landschaftsentwicklung). 1986. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750150/JAW.

The report discusses a research project dedicated to the large-scale determination and documentation of the damage to forests in Schleswig-Holstein. Analyses are based on an infrared colour aerial survey which was taken in 1983 on behalf of the Schleswig-Holstein Board of Forests. A parallel project focuses on the methodology of the plotting of aerial photographs with special regard to the damage to forests and deals with the determination of structural forest data with the help of aerial photographs. The forest structure analysis aims at determining a comprehensive range of basic data showing the regional structure of forests. Schleswig-Holstein serves as a practical example.

4549 **(NP—8770002) Cadmium, chromium, cobalt, nickel and thallium loads and their effects on different plants.** Traulsen, B.D. (Technische Univ. Berlin (Germany, F.R.)). 20 Sep 1985. 163p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770002/JAW.

The study analyses the effects of the heavy metals cadmium, chromium, cobalt, nickel and thallium on different plants. Smaller yields were indicative of a hierarchy of loads of decreasing toxicity: Thallium - cadmium - nickel - chromium - cobalt. Within the limiting values accountable for symptoms and yields nickel, chromium and cobalt proved to cause unspecific chloroses to the younger leaves. Apart from causing chloroses cadmium, if concentrations amounted to 1 μval or more deposited in the leaf joints of phaseolus vulgaris and lead to an irreversible settling of the primary and pinnate leaves. Thallium concentrations of 0.5 μval or more resulted in a decomposition of chlorophyll along the veins which is a symptom which apart from chloroses could also be observed in the case of excessive concentrations of cadmium and nickel. Long-time tests analyzing the effect of cadmium contained in misty precipitations as well as the effects of cadmium and thallium contained in soils (3 ppm in each case) proved to show the same symptoms as in the culture medium. Phaseolus vulgaris proved to be susceptible to negative effects affecting the overground parts of the plant rather than the roots. Heavy metal loads were made responsible for the generally reduced water content of all the plants concerned.

4550 **(NP—8770008) Measurement of lead, cadmium and salt deposition on the vegetation along selected roads in Kiel city.** Jungclaus, G. (Kiel Univ. (Germany, F.R.). Agrarwissenschaftliche Fakultaet). 8 Nov 1984. 169p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770008/JAW.

Lead and cadmium depositions on the vegetation along Kiel roads were determined by means of active biomonitoring. The findings are discussed, and a clear effect of traffic density on the heavy metal concentrations was found. Further studies focused on the applicability of test vegetation for determining the phytotoxicity of thawing salts on roads.

4551 **(NP—8770010) Ecotoxicological investigations for the development of a range of bioindicators for oxidizing air pollutants.** Schlueter, C. (Hohenheim Univ., Stuttgart (Germany, F.R.). Fakultaet 3 - Agrarwissenschaften 1). 16 Nov 1984. 124p. (In German). NTIS (US Sales Only), PC A06. Order Number DE88770010/JAW.

A bioindication process for oxidizing airborne pollutants was to be developed for assessing air pollution in Baden-Wuerttemberg. The response of cultured plants to the leading component of secondary oxidizing air pollution, i.e. ozone and primary NO/sub 2/ was investigated in gassing plants. 13 different varieties of kidney beans were exposed to gas in order to determine their sensitivity and to monitor the damage induced by O/sub 3/ and NO/sub 2/. There was no indication of lower yields as a result of ozone pollution. Apart from the kidney beans, also mustard, celery, lettuce, field beans, radishes, red clover, and spinach were tested for their response to ozone and NO/sub 2/. There were no visible changes after exposure to pure NO/sub 2/ at concentrations exceeding the maximum permissible values for long-term exposure set in the Clean Air Technical Guide. Exposure to a mixture of O/sub 3/ and NO/sub 2/ resulted in damage indistinguishable from ozone damage; however, the damage rate is twice as high after mixed-component exposure than after ozone exposure.

4552 **(NP—8770012) Chloroplast fluorescence as a characteristic parameter in bioindication. Microscope fluorimetry of boundary effects and SO/sub 2/ effects in mosses.** Schiele, S. (Bremen Univ. (Germany, F.R.). Fachbereich 2 - Studiengang Biologie; Bremen Univ. (Germany, F.R.). Abt. fuer Chemie). 18 Jan 1985. 156p. (In German). NTIS (US Sales Only), PC A08. Order Number DE88770012/JAW.

The applicability of chloroplast fluorescence of mosses for bioindication was investigated. Laboratory-scale SO/sub 2/ exposure experiments proved the sensitivity of chloroplast fluorescence well before any visible damage occurred.

4553 **(NP—8770013) Effects and distribution of Cd nitrate in a ruderal ecosystem in West Berlin.** Kratz, W. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Biologie). 18 Jan 1985. 307p. (In German). NTIS (US Sales Only), PC A14. Order Number DE88770013/JAW.

The decomposition of Cd-contaminated and uncontaminated litter of solidago gigantea leaves was investigated. Uncontaminated leaves were found to decompose much quicker than the litter of contaminated leaves. Decomposition is much slower in fine-mesh; Cd-contaminated bags, in which only microorganisms can be active, is much slower than in comparable wide-mesh gauze bags. In gauze bags with different mesh width, the number of soil organisms was found to decrease with increasing Cd exposure. The constituents of the solidago leaves are decomposed at the same rate in contaminated and uncontaminated leaves. The vegetation pattern in the experimental lots did not change under Cd exposure for 3 vegetation periods. The soil litter in the experimental lots was found to be the main Cd sink. In the animal population, Cd accumulates preferably in detritovores.

4554 **(NP—8770014) Investigations of the absorption of Cd from mushrooms in mice.** Zant, W. (Wuerzburg Univ. (Germany, F.R.). Medizinische Fakultaet). 6 Feb 1984. 43p. (In German). NTIS (US Sales Only), PC A03. Order Number DE88770014/JAW.

The problem concerning the absorption of Cd from mushrooms was investigated in mice. The animals were fed a lyophilized dry powder of a mushroom with a high Cd concentration (Agaricus silvicola) suspended in agar, and the Cd concentrations in the liver, kidneys, faeces, and urin were determined by flameless atomic absorption spectroscopy. In animals receiving 75 mg of powdered mushroom per animal per day (Cd concentration 3.3 μg), the Cd concentrations in the livers and kidneys were significantly higher than in the control animals. In animals given 3.3 μg per day of Cd in the form of CdCl, the Cd concentration in the liver equalled that of animals receiving powdered mushroom while the Cd concentration in the kidneys was significantly higher. In animals given 15 mg of powdered mushroom twice a week, the Cd concentrations in the liver and kidneys after three months of exposure did not differ from the control group values in any significant manner.

4555 **Intersubunit interaction at the active site of D-ribulose-1,5-bisphosphate carboxylase/oxygenase as revealed by cross-linking and site-directed mutagenesis.** Lee, E.H.; Soper, T.S.; Mural, R.J.; Stringer, C.D.; Hartman, F.C. (Oak Ridge National Lab., TN). *Biochemistry;* **26**: No. 15, 4599-4604(28 Jul 1987). Contract AC05-84OR21400.

For measurement of distances between active-site residues of ribulose-1,5-bisphosphate carboxylase/oxygenase from Rhodospirillum rubrum (a homodimer of 50.5-kDa subunits), the reaction of the enzyme with 4,4′-difluoro-3,3′-dinitrodiphenyl sulfone (which spans 9 A) has been explored. Inactivation of the enzyme by the bifunctional reagent is not associated with an increase in apparent molecular weight, thereby excluding intermolecular cross-linking. However, in the presence of urea, gel filtration of the inactivated enzyme reveals a prominent dimeric species attributed to intersubunit cross-linking. The major chromophoric peptide has been isolated from a tryptic digest of the dimer; sequence analysis of this peptide reveals that the intersubunit cross-link occurs between Cys-58 and active site Lys-166. In contrast to previous substitutions for Lys-166 introduced by site-directed mutagenesis, replacement by aspartic acid prevents association of the two subunits. In addition to identifying an intersubunit contact, these observations suggest that the catalytic site of the carboxylase is positioned at an interface between subunits and that segments of both subunits may be required for catalytic competence.

4556 **Auxin transport in an auxin-resistant mutant of arabidopsis thaliana.** Lincoln, C.; Benning, C.; Estelle, M. (Indiana Univ., Bloomington). *Plant Physiology, Supplement;* **83**: No. 4, 93(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

The authors are studying a group of allelic recessive mutations in Arabidopsis called axr-1. Homozygous axr-1 plants are re-

sistant to exogenouly applied auxin. In addition, axr-1 mutations all confer a number of development abnormalities including an apparent reduction in apical dominance, loss of normal geotropic response, and a failure to self-fertilize due to a decrease in stamen elongation. In order to determine whether this pleiotropic phenotype is due to an alteration in auxin transport they have adapted the agar block transport assay for use in Arabidopsis stem segments. Their results indicate that as in other plant species, auxin transport is strongly polar in Arabidopsis stem segments. In addition transport is inhibited by the well characterized auxin transport inhibitor N-1-naphthylphthalamic acid and the artificial auxin 2,4-D. These results as well as the characterization of transport in axr-1 plants will be presented.

5604 Other Environmental Pollutant Effects

4557 (AD-A—183462/1/XAB) Biological applications and effects of optical masers. Annual report (final), March 16-October 15, 1986. Ham, W.T.; Mueller, H.A.; Ruffolo, J.J.; Cleary, S.F.; Guerry, R.K. (Virginia Commonwealth Univ., Richmond (USA)). Apr 1987. 48p. NTIS, PC A03/MF A01.

The literature pertaining to retinal light damage from environmental and man-made optical sources prior to the last decade is reviewed with particular attention to acute and long-term chronic exposure leading to thermal and photochemical lesions of the retina. The parameters of wavelength, exposure time, and power level are given as the major factors defining thermal vs photochemical damage. Light toxicity as a function of wavelength is dealt with in some detail. In particular, wavelengths ranging from 1064 nm to 325 nm in the near-ultraviolet are studied using macaque monkeys. Exposures in the near UV were accomplished using aphakic monkeys (lens removed surgically). The histopathologies of blue light and near-ultraviolet lesions of the retina in the macaque monkey are described. Light damage to the RPE and its possible relationship to aging and macular degeneration is investigated.

4558 (AD-A—183562/8/XAB) Afferent mechanisms of microwave-induced biological effects. Final report, June 1980-August 1987. Lai, H.; Horita, A.; Chou, C.K.; Guy, A.W. (University Hospital, Seattle, WA (USA). Bioelecromagnetics Research Lab.). 12 Aug 1987. 14p. NTIS, PC A02/MF A01.

Effects of low-level microwave irradiation on neurological function were investigated in the rat. Results can be summarized in the following statements: (1) acute exposure effects the response of an animal to psychoactive drugs and changes cholinergic activity in the brain; (2) effects of microwaves are classically conditionable to environmental cues after repeated exposure. Tolerance can also develop after repeated exposure; and (3) endogenous opioids play a mediating role in certain neurological effects of microwaves. These data further our understanding on the neurological effects of microwave exposure and may have important implications in certain occupational situations in which repeated exposure to low-level microwaves is unavoidable.

4559 (AD-A—183672/5/XAB) Critique of the literature on bioeffects of radio-frequency radiation. A comprehensive review pertinent to Air Force operations. Final report, June 1982-October 1986. Heynick, L.N. (SRI International, Menlo Park, CA (USA)). Jun 1987. 781p. NTIS, PC A99/MF E04.

This report analyzes research results and other pertinent information on the biological effects of radiofrequency radiation (RFR). The frequency range of primary interest is 10 kHz to 300 GHz. The main purpose of this report is to serve as a basic reference for other documents dealing with the environmental impact of proposed or currently operating USAF emitter systems with regards to health and safety aspects of exposure to RFR. The report is divided into 7 sections with various aspects of the present knowledge regarding biological effects of RFR. More than 600 references from the world's literature are cited.

4560 (AD-A—183725/1/XAB) Treatment of laser-induced retinal injuries. Annual report, February 1985-January 1986. Belkin, M.; Naveh, N. (Tel Aviv Univ. (Israel)). 2 Apr 1986. 23p. NTIS, PC A02/MF A01.

The effect of argon-laser irradiation of the retina at various energy levels on PGE2 production by the retina-choroid, and PGE2 and protein accumulation in the vitreous cavity, was investigated and compared to the effects of sham exposures. The effect of steroid treatment on PGE2 levels following laser exposure was also examined. Results showed that both single and multiple suprathreshold applications were characterized by a biphasic increase in retinal PGE2 production, whereas multiple subthreshold exposure elicited an increase in PGE2 production of much longer duration. In eyes subjected to sham exposure, the increase in retinal PGE2 production was evident as a single peak. Moreover, laser-induced retinal burns at most of the energy levels studied, as well as sham exposure resulted in a accumulation of PGE2 and/or protein in the vitreous body.

4561 (AD-A—183863/0/XAB) Long-term bioeffects of 435-MHz radiofrequency radiation on selected blood-borne endpoints in cannulated rats. Volume 3. Plasma prolactin. Final report, August 1984-February 1986. Popovic, V.P.; Toler, J.C.; Bonasera, S.J.; Popovic, P.P.; Honeycutt, C.B. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.). Jun 1987. 53p. NTIS, PC A04/MF A01.

See also Volume 1, AD-A175 347.

Two hundred adult male white rats (Sprague-Dawley, CAMM Labs) with chronically implanted aortic cannulas were randomly divided into two groups. Animals in the first group were exposed to low-level (1.0mW/cm2) pulsed-wave 435-MHz radiofrequency radiation for approximately 22 h daily, 7 days a week, for 6 months. Animals in the second group were maintained under identical conditions but were not radiated. The chronic cannulas were used to draw 0.3 mL of aortic blood from the unrestrained, unanesthetized rats on a cyclic schedule. Plasma prolactin concentrations were determined by radioimmunoassays. Statistical analysis of the results showed no significant difference in plasma prolactin concentration between exposed and sham-exposed animals. Exposure to this low-level radiofrequency environment did not induce stresses that resulted in alteration of plasma prolactin concentrations.

4562 (AD-A—183864/8/XAB) Definition of procedure to study bioeffects of radiofrequency radiation on cell growth and differentiation. Final report, 1 March-30 October 1986. Toler, J.C.; Bonasera, S.J. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.). May 1987. 58p. NTIS, PC A04/MF A01.

This research program was conducted for the purpose of evaluating the feasibility of using an existing multi-animal radiation facility to expose a large population of experimental animals to electromagnetic radiation in the radiofrequency portion of the spectrum. The major conclusion of this program was that the multi-animal facility at the Georgia Tech Research Institute would provide a suitable exposure environment for investigating chronic RFR effects on the growth and differentiation of rapidly growing mammalian cells in vivo. This conclusion was reached in collaboration with experts in experimental and diagnostic pathology from Pathology Associates, Inc., Ijamsville, Maryland. The Appendix to this report presents a proposed protocol for a follow-on research program to investigate RFR bioeffects on cell growth and differentiation. This protocol identifies an animal model, animal population, exposure environment, exposure duration, and tissue assessment scheme appropriate for the proposed follow-on investigation.

4563 (AD-A—183953/9/XAB) Fort McClellan ICUZ (Installation Compatible Use Zone) Program. In-progress review. Singley, J. (Army Inst. for Water Resources, Fort Belvoir, VA (USA)). Nov 1986. 80p. (IWR—86-PR-4). NTIS, PC A05/MF A01.

In the interest of fulfilling its basic obligations under the Noise Control Act of 1972, the Army is presently implementing the Installation Compatible Use Zone (ICUZ) Program. ICUZ is a process intended to identify and mitigate noise impacts and programs on installations and in surrounding communities. In the inter-

est of contributing to the overall success of the ICUZ community involvement efforts, TRADOC is documenting the experiences at some installations for the benefit of each of the others. With the assistance of the Institute for Water Resources, an evaluation of ICUZ community involvement efforts at Fort Knox was undertaken in the summer of 1985.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 3167

4564 **(NP—7900978) Injury experience in sand and gravel mining, 1985.** (Mine Safety and Health Administration, Denver, CO (USA)). 1987. 105p. (IR—1188). NTIS, PC A06. Order Number DE87900978/JAW.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of sand and gravel mining in the US for 1985. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, and occupation. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report. 19 tabs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 3056, 3149

4565 **(IAEA-R—3641-F) Applicability of /sup 32/Si for groundwater dating. Final report for the period 15 December 1983-31 March 1987.** Gellermann, R.; Froelich, K.; Franke, T.; Hebert, D.; Jordan, H. (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 102p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700015/JAW.

The paper deals with the results of a study carried out to assess the applicability of /sup 32/Si for groundwater dating. Measurements of /sup 32/Si in soil samples of the unsaturated zone, of drainage waters and plant material provide the basis for estimating the /sup 32/Si initial concentration in groundwater. Different aquifers with groundwater of young and moderate ages have been selected for groundwater studies. For comparison purposes, tritium was found to be a suitable reference isotope. A quantitative interpretation of the /sup 32/Si data is generally complicated by geochemical processes, above all in the unsaturated zone. Favourable conditions concerning the use of /sup 32/Si in hydrogeology seem to exist in phreatic sand, in limestone and, depending on the thickness and composition of the unsaturated zone, in sandstone aquifers. Further improvement of the /sup 32/Si method requires deeper knowledge of the geochemical processes affecting this isotope. Refs, figs and tabs.

4566 **(LA-UR—87-2865) Application of rock varnish dating of quaternary surficial deposits in determining times of fault movement.** Harrington, C.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8704210—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014753/JAW.

From Paleoseismology workshop; Albuquerque, NM, USA (22 Apr 1987).

Rock varnish, a coating commonly found on rock surfaces in arid and semiarid regions, has a significant potential in paleoseismic studies, as a wide variety of Quaternary surfaces and surficial deposits can be dated with the rock varnish technique. If the formation of geomorphic surfaces or surficial deposits can be related to times of faulting or if faulting has broken or deformed such features, then rock varnish dating can be used to constrain maximum and minimum times of motion on the related fault.

4567 **(NEI-SE—1) Geochronological study of Proterozoic granitoids in the Gneiss Complex of south-western Sweden.** Persson, P.O. (Lund Univ. (Sweden). Dept. of Geology). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753031/JAW.

The thesis comprises Rb-Sr and U-Pb isotopic investigations. The aim of the study was to establish a geochronological framework for the whole of the Gneiss Complex and to study the influence of the metamorphic processes on the isotope systems. The Gneiss Complex is split into an Eastern and a Western segment. The latter is to a large extent made up of calc-alkaline granitoids (the Aamaal granitoids) known to have Rb-Sr whole rock ages of 1650-1700 Ma. These are interpreted as intrusion ages. The U-Pb data on zircons from Aamaal granitoids in this thesis yield ages of 1620 and 1500 Ma. The Rb-Sr systems of those rocks, which yield the lowest zircon ages are severely affected. A three-stage model for the evolution of the zircons is presented. The subsequent development of the Western Gneiss Segment, including south-eastern Norway, was essentially ensialic. When the existing age data are compiled, four periods of ensialic magmatism can be outlined: 1535-1570, 1350-1400, 1200-1270 and c. 900 Ma ago. Results from the first and third of these age-groups are presented. The zircons are in most cases interpreted to yield intrusion ages although rejuvenation is likely in some instances. The third age-group generally yields Rb-Sr isochrons which record the intrusion and whose initial Sr isotopic ratios of around 0.710 indicate rock formation by remelting of pre-existing crustal material. For the case reported here, Rb-Sr and zircon ages agree and the zircons are devoid of inherited material. In Eastern Gneiss Segment reddish microline granitoids predominate. The age data are as yet too scarce to allow a grouping. Ages of 1612, 1486 and 1140 Ma are reported. Rb-Sr whole rock dating of thin slabs yields ages between 1004 and 1071 Ma, which proves the importance of the Sveconorwegian rehomogenization. The Rb-Sr mineral ages range from 962 to 970 Ma. With 36 refs.

4568 **(YJT—86-29) Loviisa power station - final disposal of reactor waste. On the age and origin of groundwater from the rapakivi granite on the Island of Haestholmen.** Kankainen, T. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Oct 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753053/JAW.

This study forms a part of the research done to assess the suitability of the rapakivi granitic bedrock of the island of Haestholmen, southern Finland, for the management of reactor waste. The aim is to assess the residence time and the origin of the groundwater. In addition, microfossil analyses and conservative ion data were used in deciphering the origin of the groundwater. Fracture mineral studies were limited to /sup 13/C determinations on two fracture calcites. Groundwater was sampled at several levels of four drill holes, reaching to a depth of some 200 m. The isotopic results were compared with those of water from a percussion drill hole, shallow dug wells, and the Gulf of Finland. The main conclusions are based on /sup 3/H bundances in groundwater, mean residence time of groundwater deduced from /sup 14/C analyses, and stabile isotope content of groundwater, combined with conservative ion data. Additional information was gained from activity ratios of uranium, and sulphur isotope ratios of sulphate. The groundwater of Haestholmen consists of a surface layer of fresh water, and deeper down, of saline water. The fresh water flows and changes rapidly; most of it has precipitated and infiltrated less than 30 years ago. It intermixes with saline water only at the fresh-saline groundwater interface. The saline water underneath the intermediate zone is relatively stagnant. It mainly consists of sea water from the Litorina Sea stage, intermixed with less than 20% glacial melt water. The evolution of the Haestholmen groundwater towards its present stage began during the melting phase of the Weichselian glaciation. Then the groundwater conditions chanced, and infiltration of melt water along open fractures in the bedrock occured. During the Litorian Sea stage heavy saline Litorina sea water slowly infiltrated in the bedrock and displaced the fresh water almost totally. The Haestholmen island rose above the sea level more than 4000 years ago.

4569 Role of asthenosphere and lithosphere in the genesis of late Cenozoic basaltic rocks from the Rio Grande rift and adjacent regions of the southwestern United States. Perry, F.V.; Baldridge, W.S.; DePaolo, D.J. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. B9, 9193-9214(10 Aug 1987).

Late Cenozoic alkalic and tholeiitic basalts from the Rio Grande rift region display a wide range of Nd and Sr isotopic compositions which indicate the involvement of "enriched" mantle (EM), "depleted" mantle (DM), and crust in basalt petrogenesis. Isotopic compositions of alkali basalts (this study and published data) reflect the characteristics of their mantle source and correlate with tectonic setting: In the southern Basin and Range, a region of pronounced lithospheric extension and thinning, alkali basalts with ϵ/sub Nd/ = +7 to +8 are derived from DM, which corresponds to upwelled, oceanic-type asthenosphere; alkali basalts from the Great Plains, northern Rio Grande rift, and eastern Colorado Plateau, regions which have undergone less lithospheric extension, have distinctly different isotopic compositions (ϵ/sub Nd/ = 0 to +2) and were derived from EM; alkali basalts from the southeastern Colorado Plateau—Basin and Range transition zone have isotopic compositions that are intermediate between DM and EM values (ϵ/sub Nd/ = +6.6 to +3.3) and were derived from the DM/EM boundary.

5802 Geophysics

REFER ALSO TO CITATION(S) 3056, 3070

4570 (NP—8750147) Earthquakes in the Federal Republic of Germany 1982. Reports of the seismological observatories of the Federal Republic of Germany and a catalogue of important earthquakes worldwide. Henger, M.; Leydecker, G. (eds.). (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). 1987. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750147/JAW.

The annual reports provide information on seismic events in West Germany. The data are presented in the form of maps of seismic centers in West Germany (including marginal regions) and worldwide. There was no damaging seismic event in 1982. Two seismic events had the maximum intensity Io=V-VI (slight damage to plaster and chimneys), one in the Austrian Alps near Innsbruck on 1 May and the other in the Westerwald mountains near Bad Marienberg on 28 June.

4571 (OH/R—86/325/K) New geotechnical instrumentation. DeCew Falls GS [Generating Station]. Cragg, C.B.H. (Ontario Hydro, Toronto (Canada). Research Div.). 24 Feb 1987. 25p. (MICROLOG—87-04882). Ontario Hydro Research Division, Editorial Section, 700 University Ave., Toronto, Ont., Canada M5G 1X6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A review of the instrumentation at DeCew Falls Generating Station recommended that new piezometers, observation wells, and survey monuments be installed. This field work took place in October and November of 1986. A soils investigation was performed at the same time as the instrumentation installations were done. This document covers the instrumentation aspects; the soils investigation results will be reported separately. 12 figs.

4572 (UCID—21091) Basement structure of Yucca Flat from well, gravity, and seismic data. Mao, Nai-hsien. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1987. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001327/JAW.

Kriging has been applied to estimate the basement structure of Yucca Flat, at the Nevada Test Site (NTS), Nevada. The external drift approach was used to carry out the estimates from 3340 gravity data, 520 seismic timing data, 118 borehole data, and the location of nine faults. Kriging is an interpolation technique for spatially correlated data. The spatial correlation can be divided into two parts: a large-scale trend (drift) and a small-scale fluctuation of the residual after removing the trend. Traditionally, the drift is modeled internally as a simple mathematical function such as a constant, linear, or quadratic equation. However, if several types of measurements are available, and they are related to each other, then "type A" data can be used to model the drift of "type B" data, effectively combining two types of data. This calculation is called an external drift approach. In this case, the gravity data was used to model the drift associated with the seismic timing data. Then the combined results from gravity and seismic data were used to model the drift associated with the borehole data. The final result is the depth of the basement structure (Pz surface) of Yucca Flat, which is consistent with all three sets of data. The advantage of this approach is that it relies heavily on the local borehole data, and has the overall structure derived from the gravity and seismic data. This approach also avoids the difficulties of estimating a density model, which is required to interpret gravity data, or a velocity model, which is required to interpret seismic data.

4573 Locating microearthquakes induced by hydraulic fracturing in crystalline rock. House, L. (Earth and Space Sciences Division, Los Alamos National Laboratory). *Geophysical Research Letters;* **14**: No. 9, 919-921(Sep 1987).

Microearthquakes induced by hydraulic fracturing in crystalline rock at a depth of 3.5 km were located with a precision of better than 30 m to obtain information about the geometry and dimensions of the fracture system produced. The induced microseismicity was monitored by a network of five vorehole seismic stations; a total of about 800 induced events were reliably located from arrival times. Event locations show a tabular distribution that strikes 350° and dips 65° east, subparallel to the injection well. The injection was intended to produce a fracture system that would hydraulically connect two subparallel wells. A lack of fluid communication between them is consistent with a lack of induced microearthquakes near the target wellbore. The 150 m thickness of the zone of seismicity far exceeds the relative locational uncertainties. The injected fluid appears to have stimulated a zone of rock, rather than simply a single fracture. The distribution of microseismic events presumably envelopes the zone of fluid paths created by the fracture experiment.

5805 Oceanography

REFER ALSO TO CITATION(S) 4405

64 PHYSICS I

REFER ALSO TO CITATION(S) 5337

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 4230, 4231, 4677, 4677, 4938, 4944, 5175

4574 (AD-A—182995/1/XAB) Interplanetary proton (0.61 < E/sub p/ < 3.41 MeV) events observed with Pioneer 11, 1973-1986 and out to 22.4 Au. Progress report. Van Allen, J.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jul 1987. 33p. (U-OF-IOWA—87-22). NTIS, PC A03/MF A01.

A survey of interplanetary proton (0.61 < E/sub p/ < 3.41 MeV) events is summarized in graphical and tabular form for the period April 1973 through December 1986. The observations were obtained by an effectively continuous data stream from the spacecraft Pioneer 11 as it moved outwards in the solar system from 1.0 to 22.4 AU. Two-hundred and sixty-five distinct events are identified. The spectra and intensities of the protons, presumed to be originally of solar origin, are influenced dramatically by propagative and accelerative processes in the interplanetary medium.

4575 (AD-A—183687/3/XAB) Solar oscillations and convective flows as probes of structure in the subphotosphere. Final report, 2 February 1983-31 July 1986. Toomre, J.; Gebbie, K.B. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 15 Apr 1987. 28p. NTIS, PC A03/MF A01.

Application of inverse theory to the observation of high-degree five-minute solar oscillations has led to the detection of horizontal flows below the solar surface that are a combination of solar rotation and giant convection cells. The distinctive displacements in the centroids of the ridges evident in the power diagrams of the oscillations from one observing day to the next arise from different patterns of giant cells being rotated into view. Such observation of frequency splittings for the high-degree oscillation modes, combined with refinements in the inversion of the data using optimal averaging and spectral expansions, has shown that helioseismology should permit detailed mapping of velocity and thermal structures below the solar surface. Extensive theoretical studies of fully compressible magnetoconvection have shown that flows are indeed able to concentrate magnetic fields into concentrated flux sheets that are substantially evaluated of gas. The magnetic-buoyancy instabilities have been extensively studied.

4576 **(AD-A—183842/4/XAB) Interplanetary protons (e/sub p/ approx = 1 MeV) 1973-1986 and out to 22.4 Au. Progress report.** Van Allen, J.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Aug 1987. 23p. (U-OF-IOWA—87-26). NTIS, PC A02/MF A01.

This paper uses a homogeneous body of data on mean annual values N of the interplanetary intensity of protons (0.61 < Ep < 3.41 MeV) in the period 1973-1986 and over the heliocentric radial distance range 1.0 < r < 22.4 AU. It is found that the quantity N(r-sq) is well correlated with the annual mean sunspot number, with the exception of anomalously low values in 1979, 1980 (in particular), and 1981. The anomaly is attributed to a gross change in the interplanetary magnetic field associated with reversal of the polarity of the sun's polar field.

4577 **(LA-UR—87-3452) The history and development of nonlinear stellar pulsation codes.** Davis, C.G. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-8709169—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001828/JAW.

From Workshop on multimode stellar pulsations; Budapest, Hungary (1 Sep 1987).

This review is limited to the history and development of nonlinear stellar pulsation codes and methods. The narrative includes examples of practical interest in the application of these numerical methods to problems in stellar pulsation such as Cepheid mass discrepancy, the delineation of the RR Lyrae instability strip, and the question of the development of double-mode pulsation as observed in Cepheids, RR Lyrae and other variable stars. 15 refs.

4578 **(LA-UR—87-3457) An automated supernova search and the design strategy.** Colgate, S.A. (Los Alamos National Lab., NM (USA); New Mexico Inst. of Mining and Technology, Socorro (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-8707126—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001827/JAW.

From Santa Cruz summer workshop; Santa Cruz, CA, USA (13 Jul 1987).

The design considerations for an automated supernova search are reviewed. If supernova are to be found a week after explosion well before light maximum of both Types I and II, and if a rate of finding of 52 per year is justified, then one needs to keep roughly 5000 galaxies under surveillance out of a full set of 15,000 galaxies at ≃50 Mpc distance. For detection at 1% of Type I maximum light requires a 30-inch telescope, 10 photoelectrons per pixel threshold, a 128 x 128 pixel photodetector operating with a 3-second integration time, and 2 seconds to slew and settle ≃1°. A system designed to perform this function in real-time is described. 7 refs.

4579 **(LAPP-TH—171) Photinos and primordial nucleosynthesis.** Salati, P. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jul 1986. 12p. (CONF-860793—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750113/JAW.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

Photinos are among the most interesting particles predicted by supersymmetric theories. If they exist they should influence in many ways the results of the primordial nucleosynthesis i.e. the predicted primordial abundances of D, /sup 3/He, /sup 4/He (and / sup 7/Li). If photinos are stable, cosmological constraints restrict their possible mass to be either very light (M—/sub /γ < 100 eV) or to be massive (M—/sub γ/ > a few GeV), depending on the slepton and squark masses. In the case where photinos are unstable, they could create high energy photons able to photodisintegrate the light elements. The comparison between the predicted and the observed abundances allows to restrict significantly the photino mass-lifetime range: roughly speaking photinos of relatively high mass (M—/sub γ/ > 150 MeV) and low time scale (< 10/sup 3/ sec) are compatible with these abundances.

4580 **(LAPP-TH—178) Cosmological aspects of superstring models.** Binetruy, P. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Aug 1986. 22p. (CONF-860720—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750261/JAW.

From Quarks and galaxies: theoretical workshop on cosmology and particle physics; Berkeley, CA, USA (28 Jul 1986).

I consider more specifically the cosmological aspects of supersymmetry breaking in "superstring models" (grand unified models which are believed to describe the effective theory obtained by compactification of superstring theories). The most interesting aspects are related to the presence of flat directions in the scalar potential (vacuum degeneracies). These flat directions are discussed both in the hidden sector of these models (do they give rise to inflation) and in the observable sector of quarks, leptons and Higgs particles, in connection with baryogenesis.

4581 **(NBI-HE—87-42) Baryon asymmetry of the universe. A Monte Carlo study on the lattice.** Ambjoern, J.; Laursen, M.; Shaposhnikov, M.E. (Niels Bohr Inst., Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Jul 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750196/JAW.

We initiate the lattice investigation of the baryon asymmetry generation within the framework of the standard electroweak theory. We find that transitions between different gauge sectors are unsuppressed at temperatures larger than the critical tempearutre corresponding to the breaking of the electroweak SU(2)xU(1) group. The Monte Carlo data suggest that the high temperature plasma is populated with Gauge-Higgs fluctuations, which produce a change of the Chern-Simons number of +-1 during the transition, thereby creating 12 fermions due to the electroweak anomaly. If there is a Bose-Einstein condensation of these fluctuations our results indicate that the baryon asymmetry produced during the phase transition could be as large as 10/sup -6/.

4582 **(UCRL—96421) A parameter study of the r process.** Sale, K.E.; Mathews, G.J. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 8p. (CONF-870802—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000978/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

We consider the r-process production of actinide nuclei from a high temperature nucleon gas in a model which is most favorable for the r process. In this way, we can place upper limits on the value of the free electron fraction, Y/sub e/, of the material which experiences the r process. We find that for a broad range of initial nucleon densities, Y/sub e/ must be small (close to that for equilibrium neutron star matter). 11 refs., 2 figs.

4583 **Limits on the abundance and coupling of cosmic axions at 4.5<m/sub a/<5.0 μeV.** DePanfilis, S.; Melissinos, A.C.; Moskowitz, B.E.; Rogers, J.T.; Semertzidis, Y.K.; Wuensch, W.U.; Halama, H.J.; Prodell, A.G.; Fowler, W.B.; Nezrick, F.A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **59**: No. 7, 839-842(17 Aug 1987).

We report preliminary results from a search for galactic axions in the frequency range 1.09<f/sub a/<1.22 GHz. For an axion linewidth Γ/sub a/≦200 Hz we obtain the experimental limit

(g/sub a//sub γ//sub γ//m/sub a/)²rho/sub a/<1.4 x 10/sup -41/. The theoretical prediction is (g/sub a//sub γ//sub γ//m/sub a/)²rho/sub a/ = 3.9 x 10/sup -44/ with rho/sub a/ = 300 MeV/cm³. We have also searched for the presence of a continuous spectrum of light pseudoscalar particles; if we assume that the above rho/sub a/ is contained between the upper and lower frequencies of our search, then we find that g/sub a//sub γ//sub γ/<2 x 10/sup -30/ MeV/sup 1/2/ cm/sup 3/2/≃10/sup -11/ GeV/sup -1/.

4584 **Resolution of compact knots in Cassiopeia A.** Arendt, R.G.; Dickel, J.R. (Illinois Univ., Urbana; Los Alamos National Lab., NM). *Astrophysical Journal;* **315**: 567-570(Apr 1987).

Observations of the young supernova remnant Cassiopeia A at a wavelength of 2 cm have resolved small knots. The flux density of these knots decays on a 1/e time scale of about 14 yr. This is faster than the decay of the smooth features. The pressure in these knots can be estimated at 4 x 10 to the 7th dynes/sq cm. This is somewhat greater than the pressure within the smooth component of the supernova remnant. 13 references.

4585 **New evidence from Soudan 1 for underground muons associated with Cygnus X-3.** Ayres, D.S. (High Energy Physics Division, Argonne National Laboratory for the Soudan 1 Collaboration). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1083-1086(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The Soudan 1 experiment has obtained additional evidence for underground muons associated with the x-ray pulsar Cygnus X-3. We report the preliminary analysis of data recorded during the October 1985 radio outburst of Cygnus X-3, which show a significant excess of muons for a narrow range of Cygnus X-3 phases.

4586 **Search for solar neutrinos at Kamioka.** Cortez, P.b.B.; (For Kamiokande II Collaboration). (California Institute of Technology, Pasadena, California 91125). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1087-1093(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The Kamiokande II[1] collaboration upgraded the Kamioka nucleon decay experiment to allow a search for solar neutrinos. The ^{8}B solar neutrinos are detected via neutrino-electron scattering yielding electrons above the Cherenkov threshold in water. The current threshold of 10 MeV gives an expected signal of 0.1 events/day, about an order of magnitude below the background. This background is due to a combination of uranium dissolved in the water, photons generated in the rock, and beta decays from long-lived isotopes caused by the breakup of ^{16}O by cosmic ray muons traversing the detector. Each background can be reduced in the coming months and allow the threshold to be reduced to 7 MeV.

4587 **Proposed measurement of the gravitational acceleration of the antiproton.** Brown, R.E. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 436-444(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A collaboration has been formed to measure the acceleration of the antiproton in the gravitational field of the earth. The technique consists in obtaining antiprotons of the lowest energy possible from the LEAR facility at CERN, decelerating them further in the external beam line, trapping and cooling them to ultralow time-of-flight methods. The experiment has been granted CERN approval (PS-200). Present plans and initial development efforts are described.

4588 **Structural and dynamical aspects of the distant magnetotail determined from ISEE-3 plasma measurements.** Hones, E.W.; Zwicki, R.D.; Fritz, T.A.; Bame, S.J. (Los Alamos National Lab., NM, USA). *Planetary and Space Science;* **34**: No. 10, 889-901(Oct 1986).

Presented at IAGA 'Deep tail' symposium 1985.

Large lateral displacements of the magnetotail at ISEE-3 orbital distances can result from the angular variations of solar wind flow that occur frequently. To determine the tail's shape and structure from the ISEE-3 measurements it is desirable to determine quantitatively the tail's displacement during such measurements. Three-dimensional solar wind measurements by IMP-8 have been used together with a new coordinate system, the Geocentric Solar Wind (GSW) system, which reflects solar wind direction changes (as well as earth dipole motion), to estimate the location of ISEE-3 within the tail cross-section. Preliminary tests suggest that at least those changes of satellite location within the tail resulting from long term (few hour) solar wind changes can be determined by the method. Energetic ion spectra, measured in plasmoids by ISEE-3 in the distant tail and by ISEE-2 at the time of the plasmoid's departure from the near tail, have the same exponential form, distinctly different from the power law form that has earlier been ascribed to plasma sheet ion spectra. The ions are trapped in the closed loops of the plasmoid and the major anisotropy that they show is due to their convective motion with the moving plasmoid, not to field-aligned streaming.

4589 **Soft γ-ray burst GB790107.** Laros, J.G.; Fenimore, E.E.; Fikani, M.M. and others. (Los Alamos National Lab., NM, USA). *Nature (London);* **322**: No. 6075, 152-153(10 Jul 1986).

Spectral results are presented of detections of the soft γ-ray burst GB790107. Above 20 keV the spectrum is much softer than any other cosmic event observed through the apertures of the present experiments, and does not appear to belong to the general γ-ray bursts spectral distribution. However, in the 5-15 keV range the spectrum is very flat. Statistical arguments indicate that soft-spectrum events might belong to a disk population, but there is not a strong conclusion. (U.K.).

4590 **Enhancement of high-energy cosmic-ray spectrum by type-II supernovae.** Takahashi, Yoshiyuki; Miyaji, Shigeki; Parnell, T.A.; Weisskopf, M.C.; Hayashi, Takayoshi; Nomoto, Ken'ichi. (National Aeronautics and Space Administration, Huntsville, AL, USA. George C. Marshall Space Flight Center; Albama Univ., Huntsville, US. Dept. of Chemistry; Brookhaven National Lab., Upton, NY, USA). *Nature (London);* **321**: No. 6073, 839-841(26 Jun 1986).

The cosmic-ray spectrum has an intensity enhancement in the energy range 10^{14}-10^{16} eV per nucleus. Recent observations of heavy cosmic rays in this energy range indicate that the Ca/Fe ratio may be as large as 10 times the solar value. The authors suggest that pulsars in type-II supernova remnants are the origin of this component of the cosmic-ray spectrum.

4591 **Peculiar infrared and optical behaviour in Type I supernovae and the origin of the 1.2 μm feature.** Graham, J.R. (Lawrence Berkeley Lab., CA, USA). *Monthly Notices of the Royal Astronomical Society;* **220**: No. 2, 27P-31P(15 May 1986).

A small number of Type I supernovae exhibit well-defined peculiarities. In particular some Type I supernovae do not have the characteristic Si II 6150 A feature, and some do not have the 1.2μm absorption. It is noted that all supernovae which lack the infrared absorption also lack the 6150 A feature. Therefore it is proposed that these supernovae constitute a single sub-class of Type I supernovae and that the absence of Si is responsible for the lack of both the 6150 A and 1.2μm absorptions. Si is an excellent candidate as the cause of the infrared absorption because Si I has a dense array of strong lines near 1.2μm.

4592 **Radiation transfer in accretion disk coronae.** London, R.A. (Lawrence Livermore National Lab., CA). pp 121-132 of Cataclysmic variables and low-mass x-ray binaries. Lamb, D.Q.; Patterson, J. (eds.). Amsterdam, Netherlands; D. Reidel Publishing Company (1985). Contract W-7405-ENG-48.

The physics of x-ray excited accretion disk coronae is described. A numerical model for the hydrostatic inner region, including radiation transfer effects, is presented. The resulting appearance

is compared to recent observations of x-ray dips in several x-ray binaries. The author also discuss the dynamical effects of x-ray induced mass loss, which originates at large radius in the disk. 16 references, 1 figure.

4593 **Cometary comae.** Huebner, W.F. (Los Alamos National Lab., NM). pp 311-330 of Molecular astrophysics. Diercksen, G.H.F. (ed.). Amsterdam, Netherlands; D. Reidel Publishing Company (1985).

The authors knowledge about the structure and composition of a comet nucleus is inferred from observations of the cometary atmosphere (coma). However, photodissociation, photoionization, and chemistry destroy the mother molecules evaporating from the nucleus. To extract the primary information, the chemical kinetics and the physics of the coma are modeled with a computer and the results are compared with coma observations. The physics and chemistry for a dust free coma are described taking into account energy balance, multi-fluid flow for fast atomic and molecular hydrogen and the bulk fluid, and the transition from a collision dominated inner region to the free molecular flow outer region. Special attention is paid to the molecular data requirements for the current models and for extended models which will include solar wind interaction and dust. Such models are an important tool in support of the Giotto mission to Halley's comet, in the analysis and interpretation of coma observations, and in the understanding of the earliest history of the solar system. 13 references, 4 figures, 3 tables.

4594 **Solar flares: an extremum of reconnection.** Colgate, S.A. (Los Alamos National Lab., NM). pp 372-374 of Magnetic reconnection in space and laboratory plasmas. Washington, DC; American Geophysical Union (1984).

The author attempts to emphasize three points. (1) That the solar flare is that particular astrophysical phenomenon that is the extremum of reconnection. No other phenomenon demands as rapid magnetic flux annihilation as is seen in the solar flare. (2) Plasma physics experiments can and should be performed in the laboratory that model reconnection as we observe it in astrophysics. (3) The author believes that stochastic field lines derived from something similar to Alfven wave turbulence are a necessary part of reconnection. Experiments were performed 20 years ago at Lawrence Livermore Laboratory that gave a hint of what he believes is happening in the rapid reconnection in solar flares. In this session Biskamp has just made the point that is needed to break the topology in the third dimension to explain reconnection. The experiments that were performed in the laboratory years ago were ones of mapping the flux surfaces and showed that just this symmetry had been broken; namely, that a simple cylindrical geometry was no longer maintained but had produced a more complicated one. This is similar to what Ed Hones has seen with high energy particles in the magnetotail. 2 references, 1 figure.

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REFER ALSO TO CITATION(S) 5316, 5317

4595 **(AD-A—183492/8/XAB) Application of statistical-turbulence theory to convective instabilities. Technical report, 13 March 1985-30 September 1986.** Rino, C.L. (SRI International, Menlo Park, CA (USA)). 1 Nov 1986. 32p. NTIS, PC A03/MF A01.

Statistical-turbulence theories have been used effectively to characterize spectral density functions in fluid turbulence, and in turbulent plasmas, magnetic fields, and passive scalars in turbulent fluids. This report reviews the applications to convective instabilities of the turbulence theories generalized for ionospheric applications. These instabilities are believed to be the dominant structuring mechanism in equatorial spread F, artificial barium clouds, and in high-altitude nuclear plumes at late times. Emphasized is the ramifications of the cross-field anisotropy unique to convective instabilities, which have not been treated previously. The author shows that the limiting form of the one-dimensional spectral density functions measured perpendicular to the E x B drift direction is proportional to i/k where k is the wave number.

4596 **(AD-A—183542/0/XAB) Multi-technique study of ionospheric structures causing degradation in trans-ionospheric communications systems. Final report, 3 December 1983-31 January 1987.** Basu, S.; Doherty, P.; MacKenzie, E.; Hagan, M.P. (Emmanuel Coll., Boston, MA (USA)). 20 Apr 1987. 116p. NTIS, PC A06/MF A01.

Multiple diagnostics have been used at different latitude regimes of the globe to probe large- and small-scale ionospheric structures which cause degradation in trans-ionospheric communication systems. It was determined that the equatorial anomaly crest had the most disturbed F-region irregularity environment, giving rise to saturated GHz scintillation and phase scintillations as large as 16 radians at 244 MHz. At the magnetic equator, a host of techniques during the Project Condor rocket campaign in Peru established that the largest GHz scintillations maximize in association with extended 3m backscatter plane structures and that speed-receiver scintillation measurements yield irregularity drift velocitiers in fairly good agreement with the 50 MHz radar interferometer drifts. By combining in-situ data of irregularities with scintillations, a new class of extended VHF scintillation producing irregularities was isolated known as bottomside sinusoidal.

4597 **(AD-A—183696/4/XAB) Solar wind-magnetosphere-ionosphere current-voltage relationship. Memorandum report.** Fedder, J.A.; Lyon, J.G. (Naval Research Lab., Washington, DC (USA)). 29 Jul 1987. 22p. (NRL-MR—6010). NTIS, PC A02/MF A01.

The nature of the solar wind-magnetosphere-ionosphere (SW-M-I) coupling has been a subject of intense study and scientific interest. We report results from a numerical simulation of the SW-M-I system which shed light on the physics and behavior of the controlling processes. The current-voltage relationship is characteristic of a magnetohydrodynamic dynamo with a load operating near short-circuit conditions. The operation of the dynamo, its location with respect to the magnetosphere, and important implications of the results are discussed for both the earth and other planets with intrinsic magnetic fields.

4598 **(AD-A—183748/3/XAB) Geomagnetic-pulsation studies using the AFGL Magnetometer Network. Final Report, 1 Dec 1983-28 February 1987.** Hughes, W.J. (Boston Univ., MA (USA). Dept. of Astronomy). Jun 1987. 26p. NTIS, PC A03/MF A01.

This contract funded a study of geomagnetic pulsations, the lowest-frequency waves that occur naturally in the Earth's magnetosphere. The study used as its primary data source the AFGL Magnetometer Network, which recorded midlatitude and subauroral magnetic variations continuously for six years. The major aim of the study was to develop Pi2 pulsations which occur at substorm onset, as monitors and locators of magnetospheric activity. Other aims of the study were to study the higher-frequency types of continuous pulsation, which are believed to be generated via ion-cyclotron resonance in the radiation belt, and to develop data management and analysis software. These latter aims were in preparation for the upcoming CRRES mission. The midlatitude Pi2's are in a reliable indicator of substorms and their polarization pattern provides a good method of finding the local time of the main activity of a particular substorm. For small isolated substorms the center of the polarization pattern and the center of the midlatitude geomagnetic bay pattern produce by the dc substorm currents, coincide, but during more disturbed intervals this is not always true, as consecutive bays are not well separated from one another. The midlatitude signatures spatially relate the other various signatures of substorm onset seen at geosynchronous orbit and in the auroral zone. The main auroral surge forms about an hour west of the center of the Pi2 polarization pattern and the longitude at which the surge forms separates the region of space near geosynchronous orbit where the geomagnetic field becomes more dipolar from that where it becomes more taillike.

4599 **(AD-A—183789/7/XAB) R-f heating the ionosphere.** Morales, G.J. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Aug 1987. 8p. (PPG—1088). NTIS, PC A02/MF A01.

A survey of recent developments in the modification of the earth's ionosphere by powerful radio waves is presented from a general perspective of RF heating of plasmas.

4600 **(AD-A—183790/5/XAB) Self-consistent modification of a fast-tail distribution by resonant fields in nonuniform plasmas.** Morales, G.J.; Shoucri, M.M.; Maggs, J.E. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Aug 1987. 48p. (PPG—1089). NTIS, PC A03/MF A01.

An analytic study is made of the second-order modifications produced on the fast-tail electron-distribution function of a nonuniform plasma subjected to resonant excitation by wave sources. The source models considered can represent excitation by external electromagnetic waves propagating obliquely to the plasma density gradient, mode conversion of electrostatic whistlers beat of two transparent electromagnetic waves, and direct conversion from ripples in the density profile. The calculation treats the Landau damping provided by fast-tail electrons self-consistently and is applicable to plasmas having a long-density scale length L, i.e., (kDL) to the 1/3 power >> 1, where kD is the Debye wave number of the warm background electrons. A threshold condition is found for the formation of a positive slope in the tail distribution by the various excitation mechanisms.

4601 **(AD-A—183853/1/XAB) Theoretical analysis of charging data from rocket with charged-beam emission. Environmental research papers.** Dubs, C.W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 2 Oct 1986. 51p. (AFGL-TR—86-0209). NTIS, PC A04/MF A01.

To gain physical understanding, an approximate analysis is made of charging data from the flight of a three-conductor rocket at night in the lower F region of the ionosphere. Values of coefficients of potential, capacity, and induction are calculated, and a method of measuring them is given. Sheath radii are calculated. The extended probe is near the sheath's edge for 1 micro A, and inside the sheath for all other (larger) beam currents. The potential of the rear section is calculated; it is near zero, and is negative. The other potentials follow from measurements of potential differences. Probe theory is used to calculate the plasma-return current to the forward section and is found to account for the high negative values of potential measured for unsaturated beam currents. The 374 micro A and, especially, -10 mA beam-current cases are found to be highly saturated. Approximate formulae are developed to calculate the potential due to sheath charge. These, the coefficients, and the potentials give the conductor and sheath charges and the part of the conductor potentials due to the sheath. The charge on the forward section is nearly doubled due to the presence of the rear section. The potential at the position of the probe with the probe removed is calculated and found to differ greatly from the probe potential. The charging time constant due to rocket current and capacitances is an order of magnitude larger than the plasma period. The time to reach steady state is determined by the charging time constant due to capacitance for ion beam currents, and by the ion transit time for the electron beam current.

4602 **(LA—11122-MS) Physics and chemistry of late time fireball simulations without the geomagnetic field.** Symbalisty, E.M.D.; Sappenfield, D.S.; Sutherland, C.D.; Kashiwa, B.A. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001952/JAW.

This report describes the FADCAT computer code which is a version of the CAVEAT code adapted to simulate intermediate altitude fireballs. FADCAT now runs in two dimensions with all the features described herein. The three-dimensional version currently runs without the marker particles and without the Dukowicz rezone ability. We also highlight the results of two hypothetical, but realistic, burst scenarios. These are one megaton detonations: a single burst at 80 km altitude, and a double simultaneous burst at 60 and 80 km altitude. 20 refs.

4603 **(LA-UR—87-3643) Magnetic field draping about coronal mass ejecta.** McComas, D.J.; Gosling, J.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-8708141—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001805/JAW.

From 6. meeting of solar wind; Estes Park, CO, USA (24 Aug 1987).

Fast coronal mass ejecta (CMEs) accelerate and deflect the slower moving solar wind plasma which piles up ahead of them as they propagate out through the heliosphere. This acceleration and deflection, in turn, causes the interplanetary magnetic field (IMF) imbedded in the upstream solar wind to drape about the ejecta. Draping should cause substantial out-of-the-ecliptic magnetic fields at some locations ahead of CMEs, and radial fields behind and along the flanks. At the Earth, draping can be an important factor in the generation of some magnetic storms and substorms, while in the outer heliosphere draping may produce very large magnetotail-like configurations, somewhat analogous to those observed behind Venus and comets. 17 refs.

4604 (OUP—86-28, pp 24-42) **Excitation mechanisms and spectral emissions from the upper atmosphere.** Jones, A.V. (National Research Council of Canada, Ottawa, Ontario). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

This review provides a summary of the principal auroral and airglow emission features and the processes responsible for their excitation. Processes for which our current understanding is incomplete are discussed in more detail. 27 refs.

4605 (OUP—86-28, pp 43-65) **Analysis of auroral O/sup +//sub 2/ first negative bands.** Henriksen, K. (Tromsoe Univ. Norway). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

An exact numerical approach is used to compute the rotational part of the line strengths (Hoenl-London factors) for the O/sub 2//sup +/, b/sup 4/Σ/sub g//sup -/ - a/sup 4/PI/sub μ/ transition (1NG bands). The computed Hoenl-London factors enable a synthetic spectrum to be derived, which is then in the final step fitted to observed auroral O/sub 2//sup +/ 1NG bands by use of a least squares method. In this way we determine the population densities of the vibrational levels of the upper O/sub 2//sup +/ electronic state, and in addition an average rotational temperature. Our results give clear evidence that the auroral O/sub 2//sup +/ 1NG bands are mainly generated by particle impact on neutral O/sub 2/ molecules in their electronic and vibrational ground states, and that the bands are produced within the E-region.

4606 (OUP—86-28, pp 66-75) **Optical studies from space shuttle - a preliminary report of measurements on the STS 41-G mission.** Llewellyn, E.J.; McDade, I.C.; Kendall, D.J.W. (Saskatchewan Univ., Saskatoon Canada. Inst. of Space and Atmospheric Studies; National Research Council of Canada, Ottawa, Ontario). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The spatial scanning camera used on the STS-41-G mission is briefly described and some initial results from the images are presented. It is concluded that the ram-glow on the 41-G mission was significantly less than that recorded on previous shuttle flights. The airglow images suggest that it should be possible to derive atmospheric temperatures when using more sophisticated instrumentation planned for future shuttle and other satellite flights.

4607 (OUP—86-28, pp 76-77) **Thermospheric structure and auroral modeling.** Rees, M.H. (Alaska Univ., Fairbanks, USA. Geophysical Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

4608 (OUP—86-28, pp 78-90) **Effect of light scattering and diffuse reflection on atmospheric spectral measurements.** Stamnes, K.; Witt, G. (Tromsoe Univ. Norway. Auroral Observatory; Stockholm Univ., Sweden. Dept. of Meteorology). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

In optical remote sensing of airglow and auroral emissions one must account for the effect of atmospheric scattering and absorption between the emission region and the observing site. Reflections from a snow-covered ground may also contribute significantly to the measured radiation. A comprehensive radiation model is used to quantify these effects for realistic atmospheric models. In addition to Rayleigh-scattering the influence of ozone and cirrus clouds are included. Sky-brightness computations show that atmospheric scattering and ground-reflections significantly modify the emitted radiation and must be corrected for in quantitative studies of the remotely sensed emissions.

4609 (OUP—86-28, pp 91-104) **Coordinated rocket measurements of auroral X-rays and optical emissions.** Stadsnes, J.; Topphol, K.R.; Maaseide, K. (Bergen Univ., Norway. Dept. of Physics; Oslo Univ., Norway. Fysisk Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Coordinated measurements of bremsstrahlung X-rays and the optical auroral emissions N/sub 2//sup +/(427.8nm) and Hβ(486.1 nm) have been made from a high altitude sounding rocket. The rocket was flown across an extended aurora. By using narrow field detectors looking backwards at slant angles to the rocket axis, fairly good mappings of the auroral source regions could be obtained over wide areas as the rocket was spinning and coning. The emphasis in this paper is on the comparison of these source regions which reflects the spatial distribution of the energetic electron and proton precipitation. It was found that the distribution of the low energy X-rays (>2.9 keV) was fairly similar to the distribution of the auroral N/sub 2//sup +/(427.8 nm) emission. At higher X-ray energies the difference was greater. These measurements are the first we know about of this type.

4610 (OUP—86-28, pp 105-128) **Dayside auroras in relation to the interplanetary magnetic field. A case study.** Sandholt, P.E.; Egeland, A.; Lybekk, B.; Deehr, C.S. (Oslo Univ. Norway. Fysisk Inst.; Alaska Univ., Fairbanks USA. Geophysical Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Dynamics of dayside auroras, including cusp emissions, and their relation to the interplanetary magnetic field (IMF) have been investigated by optical ground-based observations from Svalbard, Norway, and IMF data from various satellites. Combined with the Svalbard program, simultaneous night-side observations from Alaska provide information on the large-scale behaviour of the auroral oval. Drift characteristics, spatial scale, time of duration and repetition frequency of auroral structures on the day-side, occuring at the time of large-scale oval expansions (IMF B/sub z/ < 0), are observed to be consistent with expected optical signatures of plasma entry from the magnetosheath, in association with flux transfer events. One case is presented, showing magnetic signatures (the DPY component) and their latitudinal location relative to polar cap and cusp emissions, for IMF B/sub z/ positive and negative values. 25 refs.

4611 (OUP—86-28, pp 129-140) **New ideas of substorm development as observed by ground-based optical instruments.** Pellinen, R.J. (Finnish Meteorological Inst., Helsinki). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Observations made with auroral all-sky camera, TV, photometers and some other ground-based instruments have revealed several new features in auroral behaviour in connection with substorms that have not earlier been discussed in the literature. The systematics of these observations hint that in order to understand more about the substorm mechanism, one has to add these new facts to the commonly accepted substorm picture. Southward turnings of the interplanetary magnetic field as well as storm sudden commencements occuring during quiet magnetospheric conditions, lead to an immediate onset of particle precipitation lasting for more than 30 min. before auroral break-up. Substorm onset starts with formation of an auroral bulge in the midnight sector. On the evening-side edge of the bulge a high-speed (up to 30 km/s) brightening propagates along the poleward edge of the pre-onset precipitation band. It is followed by a westward traveling surge having an order of magnitude lower speed. The auroras on the morning-side of the bulge behave similarly but are more irregular, sometimes containing north-south directed structures. Immediately after auroral break-up, the downward flowing field-aligned current on the morning-side edge of the auroral bulge may partially be carried by upward flowing cold ionospheric electrons producing a weak (a few hundred Rayleighs) 630.0 nm emission. These results are discussed in the light of the present knowledge of the magnetosphere-ionosphere coupling and auroral electrodynamics.

4612 (OUP—86-28, pp 141-159) **Recent developments in pulsating aurora studies.** Sandahl, I. (Kiruna Geophysical Inst. Sweden). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The field of pulsating aurora studies is reviewed. The paper begins with a short description of the characteristics of pulsating auroras and the theoretical ideas which, in view of existing experimental results, seem most important. A selection of new theoretical results and experimental results from both ground based instruments and instruments on rockets and satellites is then presented. There is now convincing evidence that the luminosity modulation is caused by modulated flux of electrons. The electron flux modulation seems to arise from a modulated resonant interaction between electrons and whistler mode waves in the equatorial plane, but the reason for the modulation is not known. Measurements concerning the drift and location of patches and the creation of Pi1 micropulsations are also discussed. Finally, some suggestions for future research are outlined. Optical measurements, especially with low light level TV, have proven to be of great importance in experimental studies of pulsating auroras. 24 refs.

4613 (OUP—86-28, pp 160-184) **Auroral and concurrent geomagnetic pulsations.** Oguti, T. (Tokyo Univ. Japan. Dept. of Physics). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Studies of the relationship between auroral and concurrent geomagnetic pulsations, PiC, in the auroral zone are reviewed, focusing on the most recent developments. It is concluded that magnetic pulsations observed on the ground are caused by temporal and spatial enhancemnents of the electric conductivity produced by pulsating precipitation of auroral electrons in the ionosphere. The relationship between auroral and concurrent magnetic pulsations has now been firmly established, not only for the magnetic pulsations on the ground, but also for those observed by a low altitude satellite above the ionosphere. 43 refs.

4614 (OUP—86-28, pp 185-198) **Pulsating aurora and hydrogen emissions.** Viereck, R.A.; Stenbaek-Nielsen, H.C. (Alaska Univ., Fairbanks, USA. Geophysical Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Analysis of hydrogen emissions in pulsating aurora indicates that the periods of the pulsations are correlated with Hβ intensity. The pulsation periods are short (a few seconds) at low Hβ intensity and increase with increasing Hβ emissions. The change in the

period appears to be mainly due to a variation in the time between individual pulses. In most of the data recorded at Poker Flat Research Range, Alaska (geomagnetic latitude 64.5/sup o/), the pulsating aurora was south of the main region of the proton aurora. However, on two nights pulsations were also observed within the proton aurora main region, and these pulsations were of short period and the period varied less with Hβ intensity. 32 refs.

4615 (OUP—86-28, pp 199-209) **Altitude distribution of some airglow features.** Lopez-Moreno, J.J.; Molona, A.; Lopez-Puertas, M.; Moreno, F.; Rodrigo, R. (Granada Univ. Spain. Dept. de Fisica). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The measurements of the vertical distribution in the nightglow of some transitions in the infrared region of the Meinel OH system and the 0-0 band of the Infrared Atmospheric System (IAS) of O 2 are presented. We have derived the concentration profiles of the vibrationally excited OH in levels v=2 to v=7 that best fit the observed emission profiles. The results show that the maxima of the concentration of each vibrational level are not at the same altitude,in disagreement with the photochemical models dealing with the OH emissions. The concentration profiles obtained are used to evaluate the reaction rate of the process: OH(v ≦ 4)+O - > 0 2(/sup 1/Δ g)+H, that is less than 4 x 10/sup 11/ cm/sup 3/ S/sup -1/ for v=1 to v=4. By using a theoretical atomic oxygen profile, we have derived the efficiency for the production of O 2(/sup 1/Δ g) by the three-body recombination of atomic oxygen that results in a yield of 0.7 of the global value for the reaction of 4.7 x 10/sup -33/ (300/T)/sup 2/. 20 refs.

4616 (OUP—86-28, pp v) **Neutral wind measurements by Fabry-Perot interferometry in Antarctica.** Stewart, K.D.; Dudeney, J.R.; Rodger, A.S.; Smith, R.W.; Rees, D. (British Antarctic Survey, Cambridge; Alaska Univ., Fairbanks, USA. Geophysical Inst.; University Coll., London, UK. Dept. of Physics and Astronomy). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

A large-aperture (150 mm), spatially scanned Fabry-Perot Interferometer (FPI) has been deployed at Halley (75.5/sup o/S, 26.8/sup o/W; L=4.2), Antarctica. Thermospheric neutral wind measurements were made by finding the Doppler shift of the OI(/sup 3/P/sup 2/ - /sup 1/D/sup 2/) 630.0 nm emission. This has allowed the first comparison to be made between southern hemisphere ground-based thermospheric wind measurements and the predictions of a three-dimensional, time-dependent thermospheric global circulation model. Geomagnetic and geographic latitude are well separated at Halley, so we may expect a distinct contrast to the dynamic behaviour observed in the more frequently studied northern polar thermosphere. Although the initial results from the experiment are in general agreement with the model, some consistent and significant differences between the observed wind field and that predicted are evident in the morning sector. These may be related to uncertainties in mapping magnetospheric boundaries to ionospheric heights in the southern hemisphere. The intensity of the 630 nm emission has been examined with respect to the maximum plasma frequency of the Es layer using data from the Advanced Ionospheric Sounder at Halley.

4617 (OUP—86-28, pp 240-251) **Upper atmosphere temperatures obtained by infrared spectroscopy.** Gerndt, R.; Offerman, D.; Blix, T. (Bergische Univ. Wuppertal Gesamthochschule Germany, F.R.; Forsvarets- Forskningsinstitutt, Kjeller, Norway). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Spectrometric and photometric techniques for the infrared part of the spectrum are used at the University of Wuppertal to obtain several parameters of the upper atmosphere. The long-term behaviour of mesopause temperatures were studied with two ground-based spectrometers. The temperatures were caluculated from the intensity-ratios of the OH(3.1)-P branch lines at about 1.5 μm. Using spectral analysis techniques, the variations of the upper mesosphere temperatures were analysed. Significant variations were found with periods of 4 to 6 days and of 10 to 20 days. The correlation of temperature variations in the stratosphere and upper mesosphere was examined. Latitudinal gradients of temperatures were also considered and compared with a reference atmosphere model.

4618 (OUP—86-28, pp 260-265) **Optical measurements of atmospheric ozone at high latitudes.** Larsen, S.H.H. (Oslo Univ., Norway. Fysisk Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

During a period of 17 years, ozone measurements with a Dobson spectrophotometer have been made in Tromsoe (70/sup o/N). The total ozone amount is evaluated from an observed log intensity ratio in the direct sunlight or in the light scattered from zenith at wavelengths in the near ultraviolet region. The total ozone amount means the ozone amount in a vertical column of the atmosphere of unit cross section. The value of the light intensity ratio depends on the ozone amount in the atmosphere, and thus the atmospheric ozone can be evaluated quantitatively by this type of ground-based observations. Information about the ozone distribution above the observing station can also be achieved from observations of the intensity ratio in the scattered sunlight from a clear zenith sky.

4619 (OUP—86-28, pp 266-275) **Lyman-α observations from a high altitude rocket.** Lauche, H. (Max-Planck-Institut fuer Aeronomie, Katlenburg-Lindau, Germany, F.R.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The Skylark 12 rocket contained one hydrogen resonance cell built by the Max-Planck Institute in Lindau, FRG. The paper deals with the Lyman-α observations obtained by this cell.

4620 (OUP—86-28, pp 311-327) **Rocket photometer experiment to study optical emissions from artificial electron beams in the ionosphere.** Maaseide, K. (Oslo Univ., Norway. Fysisk Inst.). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

A rocket photometer experiment to study the optical emissions generated by intense electron beams introduced into the ionosphere is described. An electron accelerator will eject 8 keV electrons in bursts of different fluxes into the ambient, and four photometers will measure the intensities of the N 2 2P(3805 A), the N 2/sup +/ 1N(4278A), and the Hβ(4861A) emissions generated in the near surroundings of the accelerator together with the rotational temperatures of the N 2/sup +/ ions. Both the accelerator and the photometers will be located in a small "daughter" payload which will be separated from the main vehicle on the upleg, and is expected to obtain an altitude of some 380 kilometers. (This experiment was successfully flown from Andoeya Rocket Range, Norway, on 10 November 1985). 27 refs.

4621 (OUP—86-28, pp 335-346) **Real-time system for measuring the altitude of auroral structures.** Steen, Aa. (Kiruna Geophysical Inst., Sweden). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

The altitude and the altitude distribution of auroral emissions are one of the results of processes in the ionosphere and in the magnetosphere during auroral activity. A bistatic system has been developed to determine the altitude and the altitude distribution of different auroral emissions in the magnetic meridian plane through EISCAT's transmitting station in Norway. The system makes use

of intensified one-dimensional photodiode arrays. In April 1985 the first measurements were made. Initital results, system characteristics and system configuration are reported.

4622 (OUP—86-28, pp 347-352) **Altitude of the red border in auroral forms.** Kaila, K. (Oulu Univ., Finland. Dept. of Physics). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

In very active forms the lower border of aurora can be red. This phenomen is induced by N 2 1PG emissions. An altitude of 60 to 100 km for the border where the green colour turns to the red one has been reported earlier. In this work, three substorms on 30 January, 1979 were studied to determine the altitude of the red lower border. A value of 85 +- 2 km was obtained from colour film data of four different all-sky camera stations in northern Finland.

4623 (OUP—86-28, pp 354-363) **Calibration of optical instruments for absolute intensity measurements of upper atmospheric emissions.** Stegman, J.; Murtagh, D.P. (Stockholm Univ., Sweden. Dept. of Meteorology). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Procedures for the calibration of an optical instrument for measurements of atmospheric quantal emissions are briefly outlined. The different techniques that are necessary in different spectral regions are discussed. As an example the calibration of a 0.6 m Czerny-Turner spectrometer, equipped with an imaging photon detector, is presented. 28 refs.

4624 **Coupling between the solar wind and the magnetosphere: CDAW 6.** Tsurutani, B.T.; Slavin, J.A.; Kamide, Y.; Zwickl, R.D.; King, J.H.; Russell, C.T. (Jet Propulsion Lab., Pasadena, CA). *Solar Terrestrial Environmental Research in Japan;* **9**: 66(1 Dec 1985).

Interplanetary conditions VB/sub s/, V^2B/sub s/ and epsilon are derived from ISEE 3 and IMP 8 field and plasma data for the two Coordinated Data Analysis Workshop (CDAW) 6 intervals of study and are compared with various aspects of geomagnetic activity (AE, U/sub T/, derived Joule hearing, electric potential, westward, eastward and total electrojet currents). The March 22 (day 81), 1979, interval contains two distinct periods of geomagnetic activity, both highly correlated with interplanetary feature. The start of the first active interval is caused by a southward turning of the interplanetary magnetic field (IMF) associated with the passage of a heliospheric current sheet. The start of the second interval is related to a second IMF southward turning. The geomagnetic activity intensifies when the second crossing of the current sheet, and a ram pressure increase of 4 to 6, impinges on the magnetosphere. Because the interplanetary parameters VB/sub s/, V^2B/sub s/ and epsilon decrease across the discontinuity, it is concluded that either additional energy is injected into the magnetosphere from the conversion of ram energy into magnetospheric substorm energy or some feature associated with current sheet crossing triggers the release of previously stored magnetosphere/magnetotail energy.

4625 **Magnetotail energy storage and release during the CDAW 6 substorm analysis intervals.** Baker, D.N.; Fritz, T.A.; McPherron, R.L.; Fairfield, D.H.; Kamide, Y.; Baumjohann, W. (Los Alamos National Lab., NM). *Solar Terrestrial Environmental Research in Japan;* **9**: 69-70(1 Dec 1985).

A primary goal of the Coordinated Data Analysis Workshop (CDAW) 6 has been to study the flow of energy from the solar wind through the magnetosphere and in so doing to examine the role of magnetotail storage and rapid dissipation of this energy during magnetospheric substorms. The chosen intervals for CDAW 6 analysis (March 22 and March 31 to April 1, 1979) are well suited for such studies since spacecraft were situated upstream (IMP 8 and ISEE 3) to measure magnetospheric energy input from the solar wind and spacecraft were also located in the magnetotail (ISEE 1, 2) and the midnight sector at geostationary orbit (76-059, 77-007, GEOS 2, GEOS 3) during several of the substorm periods. Using solar wind, magnetotail, and geostationary particle and field data, as well as ground-based information, the authors present the evidence for enhanced solar wind-magnetosphere coupling and concomitant increases of stored magnetotail energy. Clear examples of energy storage are found prior to the 1055 and 1435 UT substorms of March 22, as well as the 0250 UT and 2250 UT substorms on April 1 and March 31, respectively. In these cases they estimate the total energy increase in the tail prior to the substorm onsets, and they estimate the dissipation rate of this energy during the substorms themselves. Typical total energy increases in the tail ($\geq 5 \times 10^{23}$ ergs) appear to be more than adequate to supply the substorm energy dissipation inferred from ground-based and spacecraft observations.

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4626 **(AAEC/E—659) Double differential cross sections for electrons ejected from H/sub 2/, O/sub 2/, N/sub 2/, CO/sub 2/, CH/sub 4/, H/sub 2/O and Ar by 50 KeV protons.** Gibson, D.K.; Reid, I.D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700293/JAW.

Tabulated values of double differential cross section measurements are presented for electrons ejected from H/sub 2/, O/sub 2/, N/sub 2/, CO/sub 2/, CH/sub 4/, H/sub 2/O and Ar by 50 keV protons. The angular range extends from 0 to 100 deg and the electron energy from 5 to 150 eV.

4627 **(AD-A—183473/8/XAB) Spatial-emission properties of a surface-wave sustained plasma (surfatron) in helium.** Selby, M.; Rezaaiyaan, R.; Hieftje, G.M. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 1987. 16p. (INDU/DC/GMH/TR—87-07). NTIS, PC A02/MF A01.

Pub. in Applied Spectroscopy, Vol. 41, No. 5, 749-761(1987).

Spatially resolved measurements of plasma emission sources can greatly aid in their application to atomic emission spectrometry. In this study, detailed two-dimensional emission profiles of a plasma sustained by electromagnetic surface waves from a surfatron were measured with an imaging spectrometer. In helium, and under the operating conditions described, the plasma is found to posess a doughnut shape much like the inductively coupled plasma (ICP) in argon. Emission from the following types of spectral features was found to be confined to the plasma annulus: (1) He(I) lines; (2) molecular bands; (3) background continuum; (4) difficult-to-excite transitions from nonmetallic analytes. In contrast, two-dimensional profiles for metallic analytes (introduced in the form of an aerosol from a glass frit nebulizer) show localized mexima along the central axis of the plasma. Spatially resolved measurements have suggested ways in which the surfatron can be employed to advantage for atomic emission spectrometry. Possible excitation mechanisms to account for the spatial properties of the surfatron are also offered.

4628 **(BARC—1324) Stabilized x-ray generator power supply.** Saha, S.; Purushotham, K.V.; Bose, S.K. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700297/JAW.

X-ray diffraction and X-ray fluorescence analysis are very much adopted in laboratories to determine the type and structure of the constituent compounds in solid materials, chemical composition of materials, stress developed on metals etc. These experiments need X-ray beam of fixed intensity and wave length. This can only be achieved by X-ray generator having highly stabilized tube voltage and tube current. This paper describes how X-ray tube high voltage and electron beam current are stabilized. This paper also highlights generation of X-rays, diffractometry and X-ray fluorescence analysis and their wide applications. Principle of operation for stabilizing the X-ray tube voltage and current, different protection circuits adopted, special features of the mains H.V. transformer and H.T. tank are described in this report. 22 figures, 14 refs.

4629 (CONF-8708135—2) Several manifestations of Pauli correlations in energetic ion-atom collisions. Becker, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001437/JAW.

From 3. workshop on high energy ion-atom collisions; Debrecen, Hungary (3 Aug 1987).

In our discussion of Pauli correlation effects in collisions, we shall limit consideration to a fixed basis of spin-orbitals of the target, given by the static Hartree-Fock (HF) approximation, together with hydrogenic orbitals for electrons captured by the projectile. Moreover, we shall restrict attention to closed shell cases or to the case with one half-occupied s-shell, so that the mean field has spherical symmetry. The case of more general open shells requires multiplet theory which, strictly speaking, goes beyond the independent particle model (IPM) by involving a linear combination of determinants. In the case discussed here we can use the m-scheme in which many-electron states are specified by the quantum numbers k = (n,l,m/sub l/,m/sub s/) of each occupied spin-orbital. The initial state of an F-electron system will be specified by the spin-orbital labels h_1,...,h/sub F/. Reactions will be described in terms of occupancies and vacancies of spin-orbitals. 19 refs.

4630 (DOE/ER/10578—7) Hyperfine structure and isotope shift measurements of short-lived elements by laser spectroscopy: Progress report. Schuessler, H.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Oct 1987. Contract AS05-80ER10578. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002102/JAW.

Progress is reported in collinear fast ion beam laser spectroscopy on stable Xe^+ and short-lived Ba^+ ions and low pressure electron bombardment ion source. (LSP)

4631 (DOE/ER/13168—2) Theoretical atomic and molecular sciences: Progress report, second year of period April 1, 1984 through March 31, 1987. Lane, N.F. (Rice Univ., Houston, TX (USA). Dept. of Physics). 1987. Contract AS05-84ER13168. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001614/JAW.

The atomic and molecular physics program at Rice University addressed fundamental problems in the structure and collision dynamics of electrons, atoms, ions and molecules, with some emphasis on disturbed environments, such as high-temperature, ICF environments and on processes involving highly excited species. In the second year of this contract, particularly significant advances have been made on: Penning ionization of alkali atoms by metastable helium; charge transfer in collisions between light ions and atoms and molecules; excitation of highly stripped ions by proton impact in dense, high-temperature ICF plasma; vibrational excitation of polyatomic molecules by electron impact, including intermode coupling; semi-classical study of inelastic collisions between Rydberg atoms and polar molecules.

4632 (DOE/ER/13168—3) Theoretical atomic and molecular physics: Progress report. Lane, N.F. (Rice Univ., Houston, TX (USA). Dept. of Physics). 1986. Contract AS05-84ER13168. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001625/JAW.

The theoretical atomic and molecular physics program at Rice University addresses basic problems on the structure and collision dynamics of electrons, atoms, ions and molecules, emphasizing processes related to possible new energy technologies and other applications. The program focuses on collision processes under "disturbed" conditions, i.e., high levels of excitation, ionization, energy transfer, and external influences. Research projects include: collision processes in ICF plasmas; excitation and charge-transfer processes; Rydberg atom collisions; Penning ionization of atoms; excitation in electron-molecule collisions; and related topics. 48 refs.

4633 (DOE/ER/13491—335) [Atomic physics with highly charged ions]: Progress report. Richard, P. (Kansas State Univ., Manhattan (USA). J.R. MacDonald Atomic and Nuclear Science Lab.). 1987. Contract FG02-86ER13491. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000894/JAW.

This progress report covers the following topics: Angular distributions of reaction products from capture by slow multiply charged projectiles, capture from aligned molecules, production of molecular fragments by fast heavy-ion bombardment, Fe^{9+} + Ne collisions, few body collisions and other charge exchange, electron capture, ion colliding topics. (LSP)

4634 (DOE/ER/13491—336) Multiple ionization of noble-gas atoms by 120 MeV/u U^{91+} impact. Berg, H.; Crawford, H.J.; Doerner, R.; Engelage, J.M.; Flores, I.; Hagmann, S.; Kelbch, C.; Kelbch, S.; Loyd, D.H.; Pedersen, J. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik; Lawrence Berkeley Lab., CA (USA); Kansas State Univ., Manhattan (USA); Aarhus Univ. (Denmark)). 1987. Contract FG02-86ER13491. 2p. (CONF-870715—6). NTIS, PC A02. Order Number DE88001689/JAW.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

We have measured the multiple-ionization cross section of noble-gas atom by impact of 120 MeV/u U^{91+} ions (28.6 GeV) in a triple-coincidence experiment at the LBL Bevalac accelerator. This paper discusses this process and the apparatus used in this experiment. 1 ref.

4635 (DOE/ER/45282—6) Fermion simulations in systems with negative weights. White, S.R.; Wilkins, J.W. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). 14 Oct 1987. Contract FG02-86ER45282. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001709/JAW.

We investigate the use of two methods - Langevin and molecular dynamics - for simulating fermion systems with real, non-positive definite probability functions. The methods are tested on a simple one-dimensional model. Both methods have difficulties associated with the nodes of the probability function. While the Langevin equation can cross the nodes even for time steps as small as 10^{-10}, the crossing may be so violent that an equilibrium distribution is not readily achieved. The molecular dynamics system is trapped within regions bounded by the nodes, not sampling all of phase space. A hybrid Monte Carlo-molecular dynamics method is proposed which avoids these difficulties in the Langevin and molecular dynamics techniques. 16 refs.

4636 (GSI—87-34-Prepr.) Positron production in crossed beams of bare uranium nuclei. Mueller, U.; Reus, T. de; Reinhardt, J.; Mueller, B.; Greiner, W.; Soff, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Jun 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750169/JAW.

Positron creation in crossed beam collisions of high-energy, fully stripped heavy ions is investigated within the coupled channel formalism. In comparison with fixed targed collisions of highly stripped heavy-ion projectiles positron production probabilities are enhanced by more than one order of magnitude. The increase results from the possibility to excite electrons from the negative energy continuum into all bound states. The positron spectrum is shifted towards higher energies due to the absence of electron screening. Rutherford scattering as well as nuclear collisions with time delay are investigated. We also discuss briefly the filling of empty bound states by electrons from pair production processes.

4637 (INIS-mf—11037, pp 44) Monte-Carlo simulation of excitation rates of nitrogen and rare gases by subexcitation electrons. Porter, I.; Cooper, R.; Chan, D. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

4638 (ISN—85-56) Experimental device for measurement of dielectronic recombination cross section of C/sup 3+/: method of confluent beam method. Menier, A. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Sep 1985. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750473/JAW.

Description of an instrumental device allowing dielectronic recombination cross section measurement is presented. Recombination of C/sup 3+/ for high quantum number is studied. This device, using the confluent beam method, entailed the development of an electron gun producing weakly divergent beam. A detector of highly excited ion allowing a quick and accurate measurement of ion beam energy is described in detail. Beam-residual gas interaction mechanisms are studied and instrumental incertitudes are calculated.

4639 (LBL—23842) Vibrational spectroscopy of cluster ions: Two novel methods. Yeh, L.I.; Okumura, M.; Myers, J.D.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 17p. (CONF-8704211—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000617/JAW.

From CAMS/NCR workshop on molecular and cluster beam science; Washington, DC, USA (24 Apr 1987).

Two sensitive techniques are discussed for obtaining vibrational spectra of cluster ions. The first approach is to attach a H_2 molecule to the hydrated hydronium ions. Because the original goal was to study the hydrated hydronium ions, the attached H_2 is hoped to have only a small effect on the spectrum. After an O-H stretch of the cluster ion has been excited, it vibrationally predissociates, losing the H_2. By monitoring the dissociation product as a function of laser frequency, the absorption spectra of these H_3O^+ . (H_2O)/sub n/ . H_2 (n = 1,2,3) ions have been found. The second approach is to detect the vibrationally excited H_3O^+ . (H_2O)/sub n/ (n = 1,2,3) ions using an infrared multiphoton dissociation process. The procedure is to first excite from v = 0 to v = 1 in the O-H stretch using a tunable ir laser. We then make use of the fact that the density of states near v = 0 and v = 1 are very different, and the vibrationally excited ionic clusters, which contain many low frequency vibrations, are likely to be in the quasicontinuum region for the sequential excitation by a fixed frequency laser. This means that one can distinguish between ground state and vibrationally excited H_3O^+ . (H_2O)/sub n/ by using a multiphoton dissociation (MPD) process to selectively dissociate the latter using a CO_2 laser. Once again, we monitor the dissociation product ion signal as a function of the excitation frequency of the first laser to get the absorption spectra of the H_3O^+ . (H_2O)/sub n/ ions. 5 refs.

4640 (LBL-PUB—3061-Rev.) SUSIE reference manual. Belshe, R.A. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001462/JAW.

SUSIE is a program for interactive analysis of one and two dimensional spectra. It runs on the Modcomp Classic computers, using a Tektronix 4014 CRT display unit with a high-speed DMA interface and a LBL designed supplemental control panel. The original Modcomp version was written by M. Neiman (LBL PUB-3014, Feb. 1981). The current version is the result of a number of major revisions and extensions, the most significant being the addition of 2-D spectra, and the ability to access spectra which are created by the EVA event sorting program.

4641 (LYCEN—8544) Atom and molecule projectile and fast aggregate excitation, ionization and dissociation in thin targets in the out-of-charge equilibrium field. Clouvas, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Dec 1985. 130p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750495/JAW.

The aim of this experimental study is to confirm the possible existence of bound states for light atomic and molecular projectiles inside solid targets, in the MeV energy range. For this purpose we have used, various experimental methods such as charge state distribution measurements, energy loss measurements, beam foil spectroscopy and electron spectroscopy. It was confirmed that bound states of light atomic and molecular projectiles can exist in a solid medium. The various cross sections (charge exchange, excitation, ionisation, dissociation) relative to these bound states have been measured.

4642 (SAND—87-2285C) Anti-Stokes generation of 226 nm light. Reiser, C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-8709146—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001612/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

To ionize atmospheric atomic oxygen efficiently, the DELPHI mission requires high energy lasers at a few key wavelengths. The mission also constrains the weight and volume of the laser devices. Our work centers on the efficient generation of oxygen two-photon resonant light at 226 nm from the output of efficient KrF excimer lasers emitting near 249 nm by utilizing an anti-Stokes vibrational shift in H_2.

4643 (SAND—87-2371C) Buckshot: Description and comparison to experiment. Wagner, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8709146—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001358/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Buckshot is a three-dimensional magnetostatic particle code built to study Ion Focused Regime (IFR) propagation issues of relativistic electron beams. It has several novel features which distinguish it from many other particle codes. Forces on particles are computed directly by summation rather than interpolation on a computational mesh. Finite size particles are used to reduce unphysical very near collisions that can occur when particles are moved with a finite timestep. On a given timestep, particles feel only those neighbors in the same beam slice, a good approximation in the applications of interest. At present, BUCKSHOT can have up to five different particle species: relativistic beam, channel (plasma) electrons, channel ion species No. 1, channel ion species No. 2 (contaminant), and image charges (when boundaries are present). An arbitrary magnetic field can be specified. Buckshot has been used to support the 7-meter IBEX, the 7-meter TROLL, and 21-meter TROLL experiments with good agreement. 2 refs.

4644 (UCRL—96631) Theory of multiphoton ionization of atoms by strong, short pulsed lasers. Kulander, K.C. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1987. Contract W-7405-ENG-48. 16p. (CONF-870789—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000963/JAW.

From International conference on multiphoton processes; Boulder, CO, USA (13 Jul 1987).

A numerical technique for investigating the behavior of many electron atoms in intense laser fields is presented. A description of the method is followed by results of an illustrative, application to helium for a number of wavelengths and intensities. A discussion of high order ionization dynamics for this system based on these calculations is provided. 10 refs.

4645 Theory of line shapes for zero field NMR in the presence of molecular motion. Meier, P.; Kothe, G.; Jonsen, P.; Trecoske, M.; Pines, A. (Institut fuer Physikalische Chemie, Universitaet Stuttgart, Pfaffenwaldring 55, D-7000 Stuttgart 80, West Germany). *Journal of Chemical Physics*; 87: No. 12, 6867-6876(15 Dec 1987).

Dynamic molecular processes modulate dipolar and quadrupolar interactions in nuclear spin systems. Zero field NMR measures evolution arising purely from these interactions, and thus can be used to characterize molecular dynamics in disordered samples. A theory is presented which numerically simulates the effect of molecular reorientation in zero field NMR for a spin-1 nucleus or pairs of dipolar coupled spin-1/2 nuclei. Representative zero field NMR simulations are compared to their high field NMR analogs to demonstrate features which make zero field NMR a potentially useful tool for the study of molecular dynamics.

4646 Circular dichroism in photoelectron angular distributions from two-color (1+1) REMPI of NO. Appling, J.R.; White, M.G.; Dubs, R.L.; Dixit, S.N.; McKoy, V. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **87**: No. 12, 6927-6933(15 Dec 1987). Contract AC02-76CH00016;FG03-87ER60513;W-7405-ENG-48.

A detailed experimental and theoretical study of dichroic effects in photoelectron angular distributions is reported for (1+1), two-color REMPI of NO via the A $^2\Sigma^+$, v = 0 state. Optically aligned A state rotational levels are probed through ionization by circularly polarized light. Resultant photoelectron angular distributions exhibit significant left—right asymmetry, the phase and magnitude of which are shown to be related to the curvature of the excited state M/sub J/ distribution. Theoretical calculations involving a full ab initio treatment of the ionization dynamics result in circularly dichroic angular distribution (CDAD) parameters in good agreement with those derived experimentally. Additional effects including hyperfine depolarization and coherence are also discussed in relation to the observed CDAD data.

4647 Examination of the 2 $^1A_1$ states of formaldehyde and ketene including analytic configuration interaction energy first derivatives for singlet excited electronic states of the same symmetry as the ground state. Allen, W.D.; Schaefer H.F. III. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 12, 7076-7095(15 Dec 1987). Contract AC03-76SF00098.

In an accompanying paper by Lee, Allen, and Schaefer [J. Chem. Phys. 87, xxxx (1987)], an efficient formulation for the analytic evaluation of two-configuration self-consistent-field configuration interaction (TCSCF-CI) energy first derivatives is presented. In this paper the TCSCF-CI gradient method is adapted and applied to singlet excited electronic states of the same symmetry as the ground state. Since single-configuration self-consistent-field configuration interaction (SCF-CI) wave functions are unreliable for such electronic states due to the possibility of variational collapse, the TCSCF-CI method based on excited-state orbitals is the simplest means by which dynamical electron correlation can be incorporated effectively. Geometrical structures, excitation energies, and harmonic vibrational frequencies obtained with double-zeta plus polarization (DZP) and DZP+Rydberg (DZP+R) basis sets are reported for the 2 $^1A_1$ states of formaldehyde and ketene. The 2 $^1A_1$ state of H_2CO is found to have two distinct minima with C_2/sub v/ symmetry: a $(\pi \rightarrow \pi^*)^1$ valence minimum with r/sub e/(C—O) = 1.564 A and T_e = 8.50 eV, and an $(n \rightarrow 3p/\text{sub } y/)^1$ Rydberg minimum with r/sub e/(C—O) = 1.216 A and T_e = 7.93 eV. Some question exists on whether the $(n \rightarrow 3p/\text{sub } y/)^1$ state occurs experimentally at 8.11 or 7.96 eV, but in either case the agreement between theory and experiment is good.

4648 Photoabsorption cross section of XeF_2 from 150 to 275 nm by forward-scattering electron energy-loss spectroscopy. Spence, D.; Tanaka, H.; Dillon, M.A. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **62**: No. 12, 4940-4942(15 Dec 1987). Contract W-31-109-ENG-38.

Using the technique of high-incident-energy forward-scattering electron energy-loss spectroscopy, we have derived the relative photoabsorption cross section of xenon difluoride from 150 to 275 nm. Normalization of our data to two previous measurements which used conventional photoabsorption techniques shows good agreement with an early measurement over the entire spectral range, but significant disagreement with more recent data for wavelengths greater than 175 nm.

4649 Analytic representation of secondary-electron spectra. Inokuti, M.; Dillon, M.A.; Miller, J.H.; Omidvar, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **87**: No. 12, 6967-6972(15 Dec 1987). Contract W-31-109-ENG-38.

The secondary-electron spectrum, or the energy distribution of the ejected electrons resulting from charged-particle impact, is a crucial input to the microscopic modeling of radiation actions. The present article shows a general method for systematizing a bulk of data on the secondary-electron spectrum into a small number of indices. Our method is based on firm theoretical grounds, i.e., on thorough examination of the mathematical physics that governs the secondary-electron spectrum. We present several examples of the analysis of recent experimental data for proton impact.

4650 Fragmentation of CH_4 in collisions with fast highly charged ions. Malhi, N.B.; Ben-Itzhak, I.; Gray, T.J.; Legg, J.C.; Needham, V.; Carnes, K.; McGuire, J.H. (James R. MacDonald Laboratory, Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Journal of Chemical Physics;* **87**: No. 11, 6502-6506(1 Dec 1987).

Measurements of the production cross sections for singly charged molecular ions by high energy (1 MeV/amu) F/sup q/$^+$ (q = 4,6—9), Si/sup q/$^+$ (q = 5,6,8—12), and C/sup q/$^+$ (q = 3—6) projectiles incident on a CH_4 target are reported. Similar measurements for singly charged recoil ions are presented for H^+ (E = 1—11 MeV) projectiles incident on CH_4. We observed good agreement between our proton results and earlier electron measurements. Theoretical calculaiions for the sum of the cross sections for production of all singly ionized CH/sub n/ fragments from CH_4 are presented using the Born and Glauber approximations, and both calculated cross sections are in reasonable agreement with the measured cross sections. Production of CH^+_3, CH^+_2, CH^+, and C^+ fragments is analyzed both as a function of projectile charge and projectile velocity. Deviation from quasiequilibrium theory is observed in the relatively small cross section ratios of C^+ and CH^+ to CH^+_4 as a function of projectile charge.

4651 Effect of sudden rotation of electric field on dielectronic recombination. Nasser, I.; Hahn, Y. (Department of Physics, Faculty of Science, Ain Shams University, Cairo, Egypt). *Physical Review [Section] A: General Physics;* **36**: No. 10, 4704-4709(15 Nov 1987).

The effect of a sudden rotation of electric field on dielectronic recombination cross section has been investigated. Field-induced shifts of the high-Rydberg-state quantum numbers were found to partially explain the discrepancy between theory and the experiment of Mueller et al. [Phys. Rev. Lett. 56, 127 (1986)] on Mg II in the high-n end of the spectrum. The effect of n mixing was estimated for moderate and high values of n, and found to be negligible.

4652 Practical guide for 7S resonant frequency mixing in mercury: Generation of light in the 230—185- and 140—120-nm ranges. Smith, A.V.; Alford, W.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 11, 1765-1770(Nov 1987). Contract AC04-76DP00789.

We present recent measurements of refractive indices, nonlinear susceptibilities, and isotope shifts important for sum- and difference-frequency mixing through the 7/sup 1,3/S two-photon resonances of Hg. These data are presented in a form that makes it possible to make quick and accurate calculations of index-matching and mixing efficiencies in the low-intensity limit.

4653 3s—3p, 3p—3d, and 3d—4f transitions of sodiumlike ions. Reader, J.; Kaufman, V.; Sugar, J.; Olof Ekberg, J.; Feldman, U.; Brown, C.M.; Seely, J.F.; Rowan, W.L. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 11, 1821-1828(Nov 1987).

New measurements have been made for wavelengths of the 3s—3p, 3p—3d, and 3d—4f transitions of the sodiumlike ions Cu/sup 18+/, Zn/sup 19+/, Ga/sup 20+/, Ge/sup 21+/, As/sup 22+/, Se/sup 23+/, Br/sup 24+/, Kr/sup 25+/, Y/sup 28+/, Zr/sup 29+/, Nb/sup 30+/, Mo/sup 31+/, Ru/sup 33+/, Rh/sup 34+/, Pd/sup 35+/, Ag/sup 36+/, and Sn/sup 39+/. The measurements were made by photographing laser-produced plasmas and tokamak plasmas with grazing-incidence spectrographs. The energies of the transitions were also calculated with Dirac—Fock computer codes. By fitting the differences between the observed and calculated wave numbers to simple formulas, least-squares-fitted wavelengths for all sodiumlike ions from Ar^{7+} to Xe/sup 43+/ were determined. The estimated uncertainty of the fitted

wavelengths is +- 0.007 A, which makes them useful as reference values. The wavelengths range from 9 to 713 A.

4654 Reactive flux correlations functions and Monte Carlo evaluation of real time path integrals. Miller, W.H. (Department of Chemistry, University of California, and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 245-260(30 Oct 1987). (CONF-8704193—). Contract AC03-76SF00098.

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

The reactive flux correlation function provides a "direct" way to express the rate costant for a chemical reaction. i.e., it avoids having to solve first the complete state-to-state reactive scattering problem (and then discard the state-to-state information). If the reaction dynamics is "direct", only the short time (of order h-dash-barβ) quantum dynamics is necessary to determine the rate. Longer time (t>>h-dash-barβ) dynamics is required if the dynamics is not "direct", and a new methodology is described for the Monte Carlo evaluation of real time path integrals for time up to two orders of magnitude longer than h-dash-barβ/2.

4655 New decomposition of the S matrix for multichannel resonant collisions. Gazdy, B.; Bowman, J.M. (Department of Chemistry, Emory University, Atlanta, Georgia 30322). *Physical Review [Section] A: General Physics;* **36**: No. 7, 3083-3090(1 Oct 1987).

The usual decomposition of the multichannel scattering matrix near an isolated, narrow resonance is given as a sum of a direct and resonant part. The direct part of the S matrix which describes the background scattering is regular and unitary. The resonant part features a pole at the complex resonance energy, and both its magnitude and phase change rapidly as the energy varies. Given the S matrix, it is often a cumbersome task to extract the resonance energy and partial widths from the usual decomposition. We propose a new decomposition (which is related to the usual one) that overcomes this difficulty. The new resonant part is a complete analog of the single-channel S matrix. Its magnitude is constant and its phase jumps by 2π as the energy passes through the resonance. The resonant time delays for each state-to-state transition are independent of the channel indices, and exhibit the same Lorentzian shape from which the resonance energy and total width are readily obtained. The square of the magnitude of the resonant S-matrix elements are the state-to-state transition probabilities of the resonant scattering and are expressed in terms of the channel partial widths. The applicability of the proposed decomposition is demonstrated in a coupled-channel study of multichannel resonances in H-CO collisions using a global ab initio potential-energy surface.

4656 Surface states of excess electrons on water clusters. Barnett, R.N.; Landman, U.; Cleveland, C.L.; Jortner, J. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review Letters;* **59**: No. 7, 811-81[illegible] 17 Aug 1987).

Electron attachment to water clusters was explored by the quantum path-integral molecular-dynamics method, demonstrating that the energetically favored localization mode involves a surface state of the excess electron. The cluster size dependence, the energetics, and the charge distribution of these novel electron-cluster surface states are explored.

4657 Review of progress in the theory of volume production. Hiskes, J.R. (Lawrence Livermore National Laboratory, University of California Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 2-15(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The concept of the tandem negative ion generator for producing hydrogen negative-ion beams is reviewed. The dependence of negative-ion density on electron energy, electron density, axial distance in the chamber and on the level of vibrational excitation is discussed. Possible applications to magnetic fusion are limited by current densities obtained. Optimization of current density by changing the scale length is discussed. (AIP)

4658 H^- ion source scaling studies at LBL. Lietzke, A.F.; Hauck, C.A. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 259-270(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Four experiments are reported: 1) Constant arc voltage operation was compared with constant arc current operation over a similar range of plasma density. The higher arc voltage required in the constant arc current operation produced more H^-, but it was at the expense of an even larger increase in the accelerated electron current. 2) A comparison of different magnetic filter locations showed the highest accelerated H^- and the lowest e^- content at the closest filter location. 3) Beam-forming electrode aperture comparison for round apertures from 2mm to 10mm diameters and an 11 x 27mm oval slot showed a decreasing H^- and e^- with increasing aperture area. 4) Increasing accelerator voltage produced an increasing plasma potential and electron temperature and decreasing electron density in the exit chamber of the plasma source.

4659 Operation of a magnetically filtered multicusp volume source. Stevens R.R. Jr.; York, R.L.; Leung, K.N.; Ehlers, K.W. (Los Alamos National Laboratory, Los Alamos, NM 87544). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 271-280(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The results of experimental studies on an optimized version of the Lawrence Berkeley Laboratory (LBL) volume source are presented. Negative ion yields and emittance data were obtained for operation with both H^- and D^- beams. At high arc power, H^- beam currents up to 10 mA with rms normalized emittances of 0.0080πxcmxmrad were obtained from a 6.3-mm-diam emission aperture. The yields of D^- beams were approximately half those of H^- beams, and the normalized emittances were 1.7 times smaller at the same current density. The results of these studies indicate that the present operation is limited by the extraction system rather than the ion source.

4660 Characteristics of a small multicusp H^- source. Ehlers, K.W.; Leung, K.N.; Pyle, R.V.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 282-288(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

It is shown that the H^- current extracted from a magnetically filtered multicusp source can be enhanced by optimizing the extraction chamber length, by employing the proper chamber wall material, by mixing hydrogen with xenon gases in the discharge and by injecting very low energy electrons into the filter and extraction regions. A large improvement in H^- yield can be achieved by using a multicusp source with a much reduced plasma volume. In this arrangement, H^- current densities as high as 240 mA/cm^2 have been obtained from a 1-mm-diam extraction aperture.

4661 Accelerated beam experiments with the ORNL SITEX and VITEX H^-/D^- sources. Dagenhart, W.K.; Tsai, C.C.; Stirling, W.L.; Ryan, P.M.; Schechter, D.E.; Whealton, J.H.; Donaghy, J.J. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 366-377(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Beam parameters have been measured for both the Surface Ionization with Transverse Extraction (SITEX) and Volume Ionization with Transverse Extraction (VITEX) H^-/D^- ion sources. Both sources use a reflex discharge to generate the main plasma. Beam energies up to 18 keV were used for pulse lengths up to several seconds. For SITEX, Faraday cup magnetically analyzed D^- beam currents of 110 mA at extraction densities of 48 mA/cm^2 and at a source ion temperature of 4 eV have been measured. For the VITEX results, Faraday cup magnetically analyzed beam currents of up to 80 mA at extraction densities of 27 mA/cm^2 and at a source ion temperature of 0.5 eV have been measured. Virtually all extracted electrons were recovered at an energy of 10—30% of the accel beam energy, and there were none in the analyzed beam.

4662 **Circular aperture magnetron for injection into an RFQ.** Alessi, J.G. (AGS Department, Brookhaven National Laboratory, Associated Universities, Inc., Upton, New York, 11973). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 419-424(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A magnetron with a circular anode aperture and a spherical dimple in the cathode has been operated. With this configuration, a normalized emittance (90%) of 0.1π cm-mrad has been measured in both planes for an H^- current of >50 mA. Other than this symmetric emittance, the source performance is the same as with the typical anode slit and grooved cathode.

4663 **Operation of the fermilab H^- magnetron source.** Schmidt, C.W.; Curtis, C.D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 425-431(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Installation of a grooved cathode and addition of a resistive heater around the source body have greatly improved the performance of the magnetron source. Lifetimes of nine months with stable pulsed beams of 50 mA have been achieved. Improvements and operation of the magnetron source at Fermilab will be presented. Recent tests with Lanthanum hexaboride as the cathode will be discussed.

4664 **Relative importance of reflection and desorption in surface H^- sources.** (Department of Physics and Engineering Physics, Stevens Institute of Technology, Hoboken, NJ 07030). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 447-452(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

This is a discussion about the role of reflection and desorption in surface H^- sources. Design of sources to maximize the yield, to optimize the gas and power efficiencies, and to reduce the energy spectra of H^- ions is explored. Reasons for disagreement between the measured H^- energy spectra and calculations are discussed. (AIP)

4665 **Some comments on emittance of H^- ion beams.** Allison, P. (AT-2 MS-H818, Los Alamos National Laboratory, Los Alamos, NM 87544). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 465-481(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Some properties of emittance, emittance distributions, and measurement techniques are reviewed. In comparing the results of measurements with several different types of H^- sources with each other and with emittance formulae, it is concluded that the emittance of surface-type sources is dominated by the effective ion temperature. Other effects, such as ion-optical distortions, may account for the emittance of volume-type sources.

4666 **Review of computer modeling of negative ion beam formation.** Whealton, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 482-506(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A computer algorithm to study negative ion beam formation from volume-produced ion sources is reviewed. The effects of field penetration, negatively biased extraction electrodes, and transverse magnetic field on beam emittance and extractability have been delineated. Beam transport through a plasma is discussed. (AIP)

4667 **Polarized H^- source development at BNL.** Kponou, A.; Alessi, J.G.; Herschcovitch, A.; Niinikoski, T.O. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 585-592(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A polarized H^- source has been in operation at BNL for several years. It produces 500 μs pulses of —40 μA H-arrow-right$^-$ with polarization of —75% measured at 200 MeV. Normal operation is at 0.5 Hz, but the source has recently been operated at 5 Hz with encouraging results. Progress in developing a milliampere source is reported.

4668 **Neutralizer options for high energy H^- beams.** Fink, J.H. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 618-630(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

An energy spectrum of neutral beams is presented and the ranges over which various neutralizers give the most satisfactory performance is discussed.

4669 **Characteristics of an rf plasma neutralizer.** Trow, J.R.; Moses, K.G. (JAYCOR, Plasma Technology Division, Torrance, CA 90503). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 651-662(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Measurements of the electron density and temperature of a high-power, rf-driven, magnetic multicusp contained plasma are presented. The plasma chamber is a shortened version of an rf plasma neutralizer design for slab H^- beams; hence its ends have no cusp fields, but instead contain large openings to emulate the plasma lost through beam apertures. Data is presented from operation with hydrogen in the 1—10 mTorr range and rf power up to 60 kW. Peak electron densities of 1.2 x 10^{13} cm^{-3} and maximum degrees of ionization of 12% have been recorded. This density is sufficient for an H^- plasma neutralizer; but for a significant enhancement of th neutralization efficiency over that of a gas cell, the degree of ionization must be increased. Based on these results, estimates of the power requirements of a practical rf plasma neutralizer are presented.

4670 **Determination of neutral beam direction from radiation emitted by photodetached H^-.** Hershcovitch, A. (AGS Department, Brookhaven National Laboratory, Associated Universities, Inc., Upton, New York 11793). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 682-693(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Non-destructive diagnostic techniques to determine beam direction of 200 MeV H^0 atoms are analyzed. These methods are

based on excited hydrogen atoms in n = 2 and n = 3 levels due to photodetachment of H^- ions. With some development of hot cathodes, an e-beam driven ArF laser can produce H^* (2s) atoms for laser resonance fluorescence by photoneutralizing H^- ions in quantity comparable to that of a gas cell. Observation of fluorescence from spontaneous decay of H^* (2p) or induced decay of H^* (2s) can be readily used to indicated beam orientation with a 40 μrad accuracy. Measurements of minute Doppler shifts of this Lyman Alpha radiation by a spectrograph could in principle resolve beam direction to within 2.8 μrad. For schemes requiring n = 3 hydrogen atoms, a Xe laser can produce H^* (3s) or H^* (3p) atoms in quantities larger than previously published.

4671 **Magnetic fusion interest in negative ions.** Staten, H.S. (Office of Fusion Energy, U.S. Department of Energy, Washington, DC 20545). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 712-715(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The magnetic fusion program plan is reviewed. The participation of negative ion community in the magnetic fusion energy research is explored.

4672 **Electron excitation of H_2 (v'') levels to yield vibrationally excited H_2 molecules.** Hiskes, J.R. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 34-38(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Electron excitation cross sections to produce vibrationally excited H_2 molecules are calculated for molecules initially in the first and second vibrational levels. The pattern of excitation cross sections as a function of final vibrational level v'' differs from that found in previous calculations initiated from the ground vibrational level.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 4056, 4600

4673 **(DOE/ER/25031—1) Numerical methods for fluid flow problems.** Mansfield, L.E. (Virginia Univ., Charlottesville (USA). Dept. of Applied Mathematics). Sep 1987. Contract FG05-87ER25031. 8p. (UVA—527355/AM88/101). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000156/JAW.

This report presents results in computer modeling of fluid flow. Problems treated are: time-splitting methods applied to pipe flow and the backward facing step; sparse positive definite linear equation solutions on the hypercube processor; and investigation of the conjugate residual method to solve momentum equations. 3 figs. (JDH)

4674 **(FRNC-TH—2103) Contribution to the study of rotating disc induced MHD flows.** Herve, P. (Aix-Marseille-1 Univ., 13 - Marseille (France)). 1983. 261p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750106/JAW.

Influence of a magnetic field on electroconductor viscous fluid flow generated by disks in rotation is studied here. Flow in rectilinear conduct is first studied, together with velocity, force and current line repartition. Then a case more general is dealt with a toroidal conduct with disk drive. The influence of electric conductivity and of the thickness of the mobile disk are detailed. Couple study leads to think to a transmission by fluid variable by magnetic field variations. At last, a radial flow with a source in the middle of it is studied with a disk rotation. Analysis of velocity and pressure evolution shows a pump effect.

4675 **Absolute instabilities and self-sustained oscillations in the wake of circular cylinders.** Triantafyllou, G.S.; Kupfer, K.; Bers, A. (Ocean Engineering Department, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 17, 1914-1917(26 Oct 1987).

The Karman vortex street in the wake of a circular cylinder is shown to be due to an absolute instability of the flow in the near wake. A new means of instability analysis is used, involving mappings from the complex k plane to the complex ω plane.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 4087, 4124, 4962

4676 **(INIS-mf—11041) Proceedings of the 6. Warsaw symposium on elementary particle physics. Kazimierz, Poland, May 29-June 4, 1983.** Ajduk, Z. (ed.). (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej; Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej; Institute for Nuclear Studies, Otwock-Swierk (Poland)). 1983. 636p. (CONF-8305119—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW.

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

47 papers describing a status of electroweak theory, a search for new interactions, a progress in strong interactions, a chiral symmetry as well as gauge theories on the lattice and monopoles are presented. (A.S.).

4677 **(LBL—23390) Physics Division: Annual report, 1 January-31 December 1985.** (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000679/JAW.

This report summarizes the research programs of the Physics Division of the Lawrence Berkeley Laboratory during calendar 1985. The Division's principal activities are research in theoretical and experimental high energy physics, and the development of tools such as sophisticated detectors to carry out that research. The physics activity also includes a program in astrophysics, and the efforts of the Particle Data Group whose compilations serve the worldwide high energy physics community. Finally, in addition to the physics program, there is a smaller but highly significant research effort in applied mathematics. Some specific topics included in this report are: Research on e^+e^- annihilation, superconducting super collider, double beta decay, high energy astrophysics and interdisciplinary experiments, detector research and development, electroweak interactions, strong interaction, quantum field theory, superstrings and quantum gravity, vortex methods and turbulence and computational mathematics.

4678 **High energy physics in the United States.** Month, M. (Brookhaven National Laboratory Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 1-73(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

A comprehensive review of existing and planned programs and facilities within the United States which take part in the study of High Energy Physics is presented. Governmental, university, and international aspects of the programs are discussed. The philosophy behind High Energy studies and the directions by which spokesmen for the participating physicists are given. (AIP)

4679 **Cern and high-energy physics.** Schopper, H. (CERN, Geneva, Switzerland). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 74-97(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

A comprehensive review of existing and planned programs and facilities of CERN which take part in the study of High

Energy Physics is presented. Governmental, university, and international aspects of the programs are discussed.

4680 **How does the standard model stand up to the real world?.** Smith, C.H.L. (Oxford University, Oxford, England). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 298-319(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

The accumulated knowledge from experimental results within the Elementary Particles Field is compared with the theory of Quantum Chromodynamics (QCD). QCD incorporates the 3-quark composition of the delta++, hadron jets in electron-positron annihilation, and the two-gamma decay of the neutral pion. Even though other feasible models exist and certain discrepancies exist (e.g., prompt production of electron-neutrinos and muon-neutrinos) this standard model is in great shape. (AIP)

4681 **Ultrahigh Energy Hadron collider round table discussion.** Month, M. (Fermi National Accelerator Laboratory, Batavia, Il 60510). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 331-365(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

This roundtable discussion reviews the motivation, feasibility, and the planning of an 'Ultrahigh Energy Hadron Collider', the Superconducting Super Collider. (AIP)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 4125, 4168, 4225, 4225, 4226, 4231, 4824, 4830, 4835, 4865, 4866, 4894, 4894, 4898, 4964, 4965, 4971, 4979, 4983, 5006, 5052, 5079, 5115

4682 **(CEA-CONF—8887) Photo and electroproduction of heavy mesons.** Tamas, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Nov 1986. 31p. (In French). (CEA-DPH-N-S—2419; CONF-8611142—3). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753242/JAW.

From Workshop on electroproduction of K mesons and pions; Clermont-Ferrand, France (24 Nov 1986).

This report reviews first the eta/sup 0/ photoproduction then the photoproduction vector mesons and presents some results. Finally, some notes on the experimental devices which should have to be developed to undertake this study are given.

4683 **(CEA-N—2511) Search for new heavy quarks and scalar bosons at center of mass energies from 39.8 GeV to 46.7 GeV at the e/sup +/e/sup -/ storage ring Petra.** Lavagne, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Jan 1987. 352p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE87753228/JAW.

This thesis presents the search of new particles - a new quark and an hypothetical scalar boson-which would appear in the shape resonances in the total cross sections of the different processes analysed. This study was performed with the Cello detector at the e/sup +/e/sup -/ storage ring PETRA at center of mass energies from 39.8 GeV to 46.7 GeV. We find for each process-Bhabha scattering, muon pairs, real photon pairs, multihadronic events- a good agreement with the electroweak and strong interaction theories. For multihadronic events, the absence of resonance, the average value of R and the final state topology allow us to exclude the existence of a new quark of charge 2/3. Only the continuum production of a new quark of charge -1/3 is ruled out by the absence of an excess of spherical events. In the same way the absence of resonance for the other processes allows us to exclude the existence of a scalar boson and to fix upper limits on the partial widths versus its mass. The interference between the resonance and the continuum in the Bhabha scattering process allows us to give limits on these widths for masses up to 50 GeV.

4684 **(CEA-N—2512) Precise measurement of the electroweak mixing angle in the scattering of high energy neutrinos of an iron target.** Perrier, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Jan 1987. 259p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE87753248/JAW.

A precise measurement of the neutral to charged current interaction ratio has been performed in 1984 by the CDHS collaboration (CERN-Dortmund-Heidelberg-Saclay). The value of the electroweak mixing angle has been extracted using a method proposed by Llewellyn-Smith where the quark parton model enters only through small corrections.

4685 **(CEA-N—2513) Precise determination of the nucleon structure functions in charged-current interactions on an iron target.** Vallage, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Jan 1987. 324p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE87753229/JAW.

570,000 neutrino-iron and 370,000 antineutrino-iron charged-current events were obtained from the Wide Band Beam exposure of the CDHS detector at CERN in 1983, at energies ranging from 20 to 400 GeV. These large statistics allowed a precise measurement of the charged-current differential cross-sections and a detailed study of systematic effects. The nucleon structure functions have been determined in the framework of the quark-parton model, in the kinematic range: 0.015<x<0.65, 0.2<Q/sup 2/<200 GeV/sup 2//c/sup 2/. The longitudinal structure function F/sub L/(x) is in good agreement with the QCD predicted shape. Deviations from scale invariance are clearly seen from the functions F/sub 2/ and xF/sub 3/. The Q/sup 2/ evolution of the valence quark distribution has been compared with the QCD prediction in order to measure the scale parameter Λ. A good agreement is obtained only if the low Q/sup 2/ points are removed from the comparison. Our experiment favours a value of Λ between 50 and 250 MeV.

4686 **(CEA-N—2519) Comparative study of the charged current interaction νn, νp, antiνn and antiνp at high energies: measurements of the cross sections and of the structure functions.** Derkaoui, J.E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Mar 1987. 166p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750480/JAW.

We study the charged currents interactions (anti)ν D/sub 2/ using the SPS ν and antiν wide band beam and BEBC filled with deuterium. We measured the cross sections of the four interactions νn, νp, antiνn, antiνp. The structure functions of proton and neutron were worked out. Their x dependence-assuming scaling- as well as their Q/sup 2/, x dependence are obtained. Our results are compared with those from other experiments and to the QPM predictions. A scaling violation analysis was performed in the framework of QCD. The existence of nucleon effects was also investigated.

4687 **(IFVE-OEF—86-18) Production of the G(1590) and other mesons decaying into eta-meson pair in the π/sup -/p collisions at 100 GeV.** Aldi, D.; Binon, F.; Brikman, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700375/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

New data on the scalar G(1590)-meson which decays into etaeta have been obtained in the CERN SPS experiment. The eta pairs are detected with the electromgnetic calorimeter GAMS both throush their, decays into 4γ and into 8γ. The ε(1300), f(1270), F'(1525) as well as the spin 4 h(2030)-meson have also been observed to decay in the same mode. Their branchins ratios have been evaluated. The presence of hish mass spin 0 and spin 2 structures is discussed. 35 refs.; 10 figs.; 1 tab.

4688 **(IFVE-OEF—86-82) Polarization asymmetry in the π/sup -/p->eta(eta')+n charge-exchange reactions.** Arestov, Yu.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700377/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The relative sign of polarization asymmetries in the charge-exchange reactions π/sup -/p -> eta+n and π/sup -/p -> eta'+n at not large t is predicted in the frame of the simple scheme of the SU(3) mixing of the octet and singlet components of eta(549) and eta'(958). 7 refs.; 2 figs.

4689 **(IFVE-OEIPK—86-57) Inclusive properties of charmed D-mesons produced in π/sup -/p interactions at 360 GeV/c.** Agyular-Benitez, M.; Allison, V.V.; Bagg, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. (In Russian). (NA—27). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700380/JAW.

The inclusive cross sections for forward D meson production at 360 GeV/c in π/sup -/p interactions are determined: $\delta(\pi$/sup -/p -> D/sup 0//D-bar/sup 0/+X/sub F/)=(10.1 + 2.2)μb, $\delta(\pi$/sup -/p -> D/sup +- /+X/sub F/)=(5.7 +- 1.6)μb. The distribution in X/sub F/ for X/sub F/>0 has the form dσ/dX/sub F/ =107/sub -37//sup +39/(1-X/sub F/)/sup 7.5(sub -1.7 + 2.5)/ +5.4/sub -3.8//sup +6.0/(1-X/sub F/)/sup 0.7(sub -0.7 + 1.0)/ μb, with evidence for leading D production. The P/sub T//sup 2/ distribution is exponential with slope parameter n=-1.18/sub -0.16//sup +0.18/ (GeV/c)/sup -2/. The data are compared with predictions from first-order calculations of QCD in the coalescence model. 14 refs.; 3 figs.

4690 **(IFVE-OEIPK—86-116) Study on the quasi-two-particle channels of the K/sup +/p -> K/sup 0/pπ reaction at 32 GeV/c.** Gerdyukov, L.N.; Shlyapnikov, P.V.; Makharadze, T.G.; Shoshiashvili, Sh.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700381/JAW.

Submitted to the journal Yad. Fiz. .

The total and differential cross sections of the quasi-two-body channels K/sup +/p -> K*/sup +/(890)p, K*/sup +/ (1430)p and K/sup 0/Δ/sup ++/(1236) of the reaction K/sup +/ p -> K/sup 0/pπ/sup +/ are measured at 32 GeV/c in the "Mirabell" bubble chamber experiment. Comparison is made with the data at other energies and with the results of K/sup -/p experiment at 32 GeV/c. 12 refs.; 6 figs.

4691 **(IFVE-ONF—86-134) Observation of the rho/sup 0/ and π/sup -/ mesons resonant state in the A/sub 3/ region.** Antipov, Yu.M.; Batarin, V.A.; Bezzubov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700383/JAW.

Submitted to the journal Yad. Fiz. .

A clear enhancement in the rho/sup 0/ effective mass spectrum has been observed in the A/sub 3/ region at π/sup -/ dissociation into rho/sup 0/π/sup -/-system on Cu nucleus. Partial wave analysis shows that this enhancement is due to the P-wave and has a resonant origin. 4 refs.

4692 (INIS-mf—11041, pp 117-123) **High p/sub T/ baryon production.** Breakstone, A.; Buchanan, C.D.; Campanini, R. 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

High p/sub T/ proton and antiproton production has been measured for three different production angles at $\sqrt{s}$ = 63 GeV using the SFM detector at the CERN ISR. The ratio of baryon production to meson production exhibits a characteristic dependence on θ and p/sub T/. Diquark scattering as one source of high p/sub T/ baryons is discussed. The observation of a short range baryon number correlation on the other hand indicates that production of baryons/antibaryons in the fragmentation chain of a scattered quark or gluon may be particularly important for high p/sub T/ antiproton production.

4693 (INIS-mf—11041, pp 197-228) **DELPHI: A LEP experiment for physics in the $\sqrt{s}$ = 100 - 200 GeV region.** Schaeffer, M. (9150195FR; Strasbourg-1 Univ., 67, France). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Experimental status of particle physics is presented. So called "standard model" based on a SU3/sub c/ x SU2/sub L/ x U1 gauge group which generates strong (QCD) and electro-weak forces is shortly described. The next generation experiments as well as future e/sup +/ e/sup -/ physics in the 100 GeV region are mentioned. The DELPHI project is described in detail. (A.S.).

4694 (INIS-mf—11041, pp 91-110) **Selected recent results from PETRA at DESY.** Criegee, L. (Deutsches Elektronen-Synchrotron, DESY, Hamburg, Germany, F.R.). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

QCD-related topics from e/sup +/e/sup -/ annihilation into hadrons are discussed, like evidence for differences between gluon and quark jets, a new determination of α/sub s/ from energy-energy correlations and possible indications for the Q/sup 2/ dependence of α/sub s/.

4695 (INIS-mf—11041, pp 349-362) **Accelerator studies of neutrino oscillations. First results from a low-energy experiment at CERN.** Guyot, C. (European Organization for Nuclear Research, Geneva, Switzerland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A review of the experimental situation is given. The first results of an experiment performed at CERN by the CERN-Dortmund-Heidelberg-Saclay-Warsaw Collaboration which compares the event rates at two distances are presented. No evidence for ν/sub μ/ oscillations is found. At the 90% confidence level, δm/sup 2/ values between 0,3 and 90 eV/sup 2/ are excluded for maximal mixing.

4696 (INIS-mf—11041, pp 363-387) **Results from the UA2 experiment at the CERN p-barp-collider. Evidence for W ->eν decays.** Haenni, H. (Bern Univ., Switzerland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The results from a search for single,isolated, high transverse momentum (p/sub T/) electrons with large missing transverse energy at opposite azimuth, carried out by the UA2 collaboration with their detector at the CERN p-barp-collider are presented. A total of 35 such events, compatible with being electrons from the process W ->eν, where W is the charged intermediate vector boson of the weak interaction, has been found. There is also evidence for electron pairs having the properties expected for decays of the neutral weak boson Z/sup 0/.

4697 (INIS-mf—11041, pp 53-59) **Search for decay of heavy neutrinos.** Bergsma, F.; Dorenbosch, J.; Jonker, M. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica, NIKHEF, Amsterdam, Netherlands). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A search for heavy neutrinos with mass below 490 MeV was performed by the CHARM Collaboration using the neutrino beam

produced by the dump of 400 GeV protons and the 400 GeV wide-band neutrino beam.

4698 (INIS-mf—11041, pp 111-116) **Comparison of deep inelastic data and QCD predictions.** Nowak, W.D. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Measurements of the structure function F/sub 2/ in deep inelastic lepton nucleon scattering experiments and their comparison with perturbative QCD predictions are briefly reviewed. Indications for nuclear effects in deuterium others than Fermi motion as seen comparing different measurements of the d/u quark distribution ratio are presented.

4699 (INIS-mf—11041, pp 463-479) **Selected topics on two gamma physics.** Kovacs, F. (Paris-6 Univ., 75, France. Lab. de Physique Nucleaire et de Hautes Energies). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Some topics related to two photon physics are presented and the different experimental results are reviewed. The cross sections for resonance production, four pions final states and hadron pair production are discussed. The expression of photon structure function which differs in different models is analysed. (M.F.W.).

4700 (INIS-mf—11041, pp 125-160) **Jet observation in UA1 experiment at the CERN proton-antiproton collider.** Ghesquiere, C. (College de France, 75 - Paris). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A review is made of the status of jets studies by the UA1 Collaboration at the CERN pp-bar collider at $\sqrt{s} = 540$ GeV. The production of jets is observed and the quantitative features of the production are shown to agree with QCD expectations. The fragmentation properties of jets are also analysed and compared to jet properties observed at PETRA. No striking difference is observed.

4701 (INIS-mf—11041, pp 389-444) **Search for the weak intermediate bosons at the CERN pp-bar collider.** Kozanecki, W. 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Two searches made on data recorded at the CERN Proton-Antiproton Collider: one for isolated large-transverse-energy electrons with associated missing energy, the other for high-mass e/sup +/e/sup -/ and μ/sup +/μ/sup -/ pairs are reported. A total of 52 electron-neutrino pairs and 6 lepton-antilepton pairs have been observed with negligible background. The characteristics of these events fit well the hypothesis that they are produced by the processes pp-bar -> W/sup +-/X, with W/sup +-/-> e/sup +-/ν, and pp-bar -> Z/sup 0/X, with Z/sup 0/ -> e/sup +/e/sup -/ or μ/sup +/μ/sup -/. Here W/sup +-/ and Z/sup 0/ are the Intermediate Vector Bosons postulated by the unified theory of weak and electromagnetic interactions.

4702 (INIS-mf—11041, pp 481-496) **Results from the UA2 experiment at the CERN p-barp-collider. Measurement of large transverse momentum jets.** Haenni, H. (Bern Univ., Switzerland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The production and properties of high transverse momentum hadron jets which have been measured using the highly segmented UA2 central calorimeter are described. In particular the evidence for two jet dominance is presented and some characteristics of a sample of two-jet events with invariant masses up to 200 GeV/c/sup 2/, including measurements of their fragmentation properties, angular distributions and observation of additional energy clusters accompanying the two jet system are given. Cross sections for inclusive jet production in the jet transverse momentum range between 30 and 100 GeV/c and for the two-jet invariant mass distribution in the mass range from 60 to 200 GeV/c/sup 2/ are presented.

4703 (ISN—86-74) **Research of a parity violation effect in the neutron-proton interaction.** Idrisssi Fakhr-Eddine, A. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1986. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750246/JAW.

The aim of this work is to search for a weak effect in the radiative capture of polarized cold neutrons by proton. The asymmetry A/sub γ/ of the emitted photons is measured. In this process, the asymmetry is du to the parity mixing in the nuclear states and it is dominated by neutral current exchange. The experimental set up was performed for high statistic and low systematic effects. A beam of intense polarized cold neutrons at the Institue Laue-Langevin (ILL) has been used for this experiment. The accurate lebel achieved is better by a factor 5 to the last experiment but it does not contrained recent predictions.

4704 (ISN—86-77) **Bugey Neutrino Oscillation Experiment. Status and a New Neutrino Detector.** Koang, D.H. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jul 1986. 5p. (CONF-860741—26). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750089/JAW.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

After recalling the results of the previous experiment, the status of the next one and the new electron antineutrino detector of high efficiency are presented.

4705 (LA—10956-C, pp 4-12) **Address to the LAMPF users groups.** Garvey, G.T. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The director of LAMPF briefly reviews some of the recent research performed at the facility and discusses projects and funding for the near- and long-term future. Among the significant experimental accomplishments mentioned are observation of interference between weak charged and weak neutral currents, studies of rare decay processes and results on pion-helium 4 scattering. In the near term there are plans to measure muon leptonic decay with great sensitivity and the construction of the Large Cherenkov Detector. Longer term projects look equally exciting particularly those concerned with studies of the application of QCD to nuclei.

4706 (LA—10956-C, pp 13-14) **Summary of a report on MP division 1986 LAMPF users meeting.** Hagerman, D.C. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The major goals of MP Division are to participate in the highest possible quality research program to set a world standard for operation and development of an accelerator based research facility, to commission, develop, and operate the LANCE/WNR beam delivery system, and to prepare for a future major facility upgrade. Major physics initiatives include the MEGA experiment and the NPL upgrade program. MEGA, a measurement of a rare decay mode of the muon, is a collaborative effort of 10 institutions led by a member of MP Division; development and construction of this experiment require careful planning and effective cooperation if the scientific goals are to be met in a timely manner. The NPL upgrade program includes a new optically pumped, polarized ion source, a neutron time-of-flight facility (NTOF), and a new medium-resolution spectrometer (MRS). Other physics programs include the three

major spectrometers supported by MP Division (HRS, EPICS, and the Clamshell), charge-symmetry studies using pions, proton-nucleus structure studies, pion-nucleus reaction-mechanism studies, and study of muon catalysis. Neutrino experiments continue as an important element of the research program with the possibility of a major neutrino detector (LCD) being constructed in a few years for a precise measurement of the sin²theta/sub w/. One intriguing offshoot of the neutrino program is a measurement of high-energy events from Cygnus; this measurement is being made through parasitic use of an existing detector complemented by an array of smaller particle detectors.

4707 (LA—10956-C, pp 15-16) **Annual report of the board of directors to the LAMPF users group.** Preedom, B. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

A variety of administrative subjects are discussed in this brief report. Among them are the awarding of the Louis Rosen prize, the election of officers to the group, discussions with new LAMPF management and the Technical Advisory Panel. Other matters outlined are U accounts, housing problems, schedule changes and open access to LAMPF facilities.

4708 (LA—10956-C, pp 17-22) **Physics at P³.** Koltun, D. (Univ. of Rochester, NY). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

A brief review of several projects currently running at this LAMPF facility is given. Experiments include spin studies via pion-proton charge-exchange interactions, charge exchange in nuclei, pion capture and pion and eta meson production in pion reactions. The particle production experiments are exploratory.

4709 (LA—10956-C, pp 23-61) **Physics at HRS.** Crawley, G.M. (Michigan State Univ., East Lansing). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The high resolution spectrometer at LAMPF was planned during the construction of the accelerator and was actually commissioned in 1976. The principle motivation for HRS was to permit a wide range of nuclear spectroscopic measurements at the high proton energies available at LAMPF. However the point emphasized in these brief remarks today is that not only were these kinds of measurements possible but a wide range of other kinds of measurements have also been made. The ability to remove elastic scattering or any other unwanted but prolific reaction from the counters has proved a very valuable property of the magnet and has led to diverse uses of HRS. In addition, the flexibility of the focal plane detectors including the focal plane polarimeter has allowed a whole range of spin studies which have led to new insights both in reaction theory and in the structure of particular kinds of nuclear states especially spin-flip excitations. A few experiments which illustrate this diversity are described.

4710 (LA—10956-C, pp 112-131) **Muonium and MEGA.** White, D.H. Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

An overview of the physics that is done at LAMPF using muonium as a vehicle to prove particle properties, and a similarly general treatment of MEGA and its motivation is given. This article is not intended to be other than an introduction to these topics, and for definitive treatments the authors refer the reader to references.

4711 **(LAL—86-25) Search for axions in electron bremsstrahlung.** Davier, M.; Jeanjean, J.; Nguyen Ngoc, H. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750091/JAW.

This paper presents the results of a search for short-lived axions produced by electron bremsstrahlung in a beam dump.

4712 **(LAL—87-03) Baryon pair production in J/psi decays.** Pallin, D.; Ajaltouni, Z.; Falvard, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753231/JAW.

The decays of 8.6 millions of J/psi produced at DCI in the DM2 detector are analyzed to measure baryon pair production. Angular distributions for J/psi->pantip, ΛantiΛ, Σ/sup 0/antiΣ/sup 0/ are in good agreement with first order QCD predictions. New measurements are given for the branching ratios of these decays. 16 figs, 3 tab.

4713 **(LAL—87-04) Study of SU(2) and SU(3) violations in J/psi baryonic decays.** Henrard, P.; Ajaltouni, Z.; Dekmouche, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750251/JAW.

A systematic study of flavour SU(2) and SU(3) forbidden baryonic decays has been performed. First measurements of branching ratios are given for the J/psi decays. These SU(3) forbidden decays are not strongly suppressed relative to the SU(3) allowed processes and they cannot be explained by purely electromagnetic effects.

4714 **(LAL—87-07) Measurement of the W mass at LEP 200.** Bijnens, J.; Zeppenfeld, D.; Kunszt, Z. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1987. 37p. (CONF-8609223—3). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753232/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

Each of the four LEP experiments can measure in at least three ways the mass of the W boson at LEP 200 with an accuracy of the order of 100 MeV (or better). W mass measurement from the threshold behavior of σ (e/sup +/e/sup -/->W/sup +/W/sup -/), W mass reconstruction using the W decay products, and W mass reconstruction from the end point of the lepton energy spectrum. The integrated luminosity of 500 events/pb used in this study provides a better statistical accuracy (50-60 MeV) but it appears difficult to control the systematical uncertainties at such a level. All the methods proposed in this report require the knowledge of the machine beam energy which gives in any case an absolute limit on the W mass measurement accuracy. Then, the theoretical interest in measuring M/sub W/ at the 1 o/oo level is discussed. 22 figs; 25 refs.

4715 **(LAL—87-09) Study of the reaction e/sup +/e/sup -/->W/sup +/W/sup -/.** Blondel, A.; Raimondi, P.; Schlatter, W. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1987. 36p. (CONF-8609223—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753233/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

The reaction e/sup +/e/sup -/->W/sup +/W/sup -/ provides an unique opportunity to test some important aspects of the Standard Model. After a review of the basic relevant measurements, data are presented which simulate the performance of LEP detectors for this process around 95 GeV beam energy. Of particular interest are measurements of the W helicity providing new information on the process. The role of beam polarization is discussed in some detail. 32 figs; 15 refs.

4716 **(LAL—87-31) Tests of quantum electrodynamics at the α/sup 3/ and α/sup 4/ orders and search of excited leptons with the CELLO detector at PETRA.** Janot, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1987. 244p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750503/JAW.

Single - and double - Bremsstrahlung processes in e/sup +/e/sup -/ annihilation have been studied in order to perform QED

tests up to the 3rd and 4th orders of perturbation theory on one hand, and to detect possible excited leptonic states on the other hand. An integrated luminosity of about 130 pb/sup -1/, accumulated with the CELLO detector at PETRA at center of mass energies ranging from 35 to 46.8 GeV has been analysed. In order to compare data with the QED predictions, simulation programs had to be developed, in particular for the annihilation into 4 photons. For all the processes, good agreement with QED is observed and new limits are derived for excited leptonics states.

4717 **(LBL—23738) Charged hadron production in e^+e^- annihilation at $\sqrt{s} = 29$ GeV.** Wolf, Z. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001394/JAW.

Data from the Time Projection Chamber at the SLAC storage ring PEP have been used to study the inclusive production of charged hadrons. Particles were identified by simultaneous dE/dx and momentum measurements. Cross sections and particle fractions for π^{+-}, k^{+-}, and p(anti p) are given as a function of several variables. Predictions of various hadronization models are compared to the data. A comparison is made with other fragmentation processes.

4718 **(LPC—87-02) Azimuthal correlation in $\gamma\gamma$ collisions.** Ong, S.; Kessler, P. (Amiens Univ., 02, France). (College de France, 75 - Paris. Lab. de Physique Corpusculaire). Jan 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750674/JAW.

We are showing that, in single-tag measuremeats of $\gamma\gamma$ collision processes leading to 2-body or quasi 2-body final states, azimuthal correlations may be used in order to check dynamic models. Various applications, regarding fermion or boson pair production, are treated.

4719 **(MPI-PAE/Exp.El.—182) Experimental test of the PCAC-hypothesis in charged current neutrino and antineutrino interactions on protons.** Jones, G.T.; Jones, R.W.L.; Kennedy, B.W.; O'Neale, S.W.; Klein, H.; Morrison, D.R.O.; Schmid, P.; Wachsmuth, H.; Miller, D.B.; Mobayyen, M.M. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Birmingham Univ. (UK); Imperial Coll. of Science and Technology, London (UK). Dept. of Physics; Oxford Univ. (UK). Dept. of Nuclear Physics; University Coll., London (UK). Dept. of Physics and Astronomy). Aug 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750448/JAW.

Data obtained with the bubble chamber BEBC at CERN are used for the first significant test of Adler's prediction for the neutrino and antineutrino-proton scattering cross sections at vanishing four-momentum transfer squared Q/sup 2/. An extended vector meson dominance model (EVDM) is applied to extrapolate Adler's prediction to experimentally accessible values of Q/sup 2/. The data show good agreement with Adler's prediction for Q/sup 2/ -> 0 thus confirming the PCAC hypothesis in the kinematical region of high leptonic energy transfer $\nu > 2$ GeV. The good agreement of the data with the theoretical predictions also at higher Q/sup 2/, where the EVDM terms are dominant, also supports this model. However, an EVDM calculation with PCAC is clearly ruled out by the data.

4720 **(PCCF-T—87-01) Production of pseudoscalar and tensor mesons associated with vector mesons in the J/PSI decays: study of the gluonic components.** Jnad, H. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). May 1987. 190p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750504/JAW.

The Quantum Chromodynamic is now regarded as the theory of the strong interactions; it requires a local gauge invariance associated with the SU(3) colour group governing these interactions. Due to the non-abelian nature of SU(3) colour group in the eight bosons of zero mass, the gluons can interact with each other leading either to physical bound state with no quark content called glueballs or to an additive gluonic component for some particles like eta and etaprime. The final states coming from the decays of the J-psi particle are very well suited to look for such effects. This thesis is dealing with both the aspects of the question. We have checked at first the hypothesis of a gluonic component in the pseudoscalar mesons eta and etaprime for which the GELL-MANN-OKUBO mass formula does not work. For this purpose, the measurement of several branching ratios for the decays of J-psi into vector + pseudoscalar have been performed allowing to compute the value of the qantiq components. It is worth pointing out that the first value of the branching ratio for the decay J-psi in Phi + D has been obtained. In the second part, we have studied whether the theta could be a parely gluonic, thus a flavor singlet, state or not. The K anti K invariant mass spectrum for J-psi decaying into omega + K anti K shows a resonant state whose mass and width are compatible with those of the theta. The experimental values obtained for the corresponding branching ratio, compared with those coming from the gamma-K anti K and phi-K anti K production enhances the hypothesis for the theta to be a flavour singlet.

4721 **(PITHA—87-09) Measurement of electroweak parameters at PETRA.** Martyn, H.U. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 1A und 1. Physikalisches Inst.). May 1987. 17p. (CONF-870390—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750165/JAW.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Results on electroweak neutral current interactions from PETRA experiments are reviewed. Interference effects manifesting themselves in charge asymmetries have been observed in lepton pair production as well as in charm and bottom quark production. Direct weak contributions due to Z/sup 0/ propagator effects are clearly observed through the rise of the total hadronic cross section at the highest energies. The data will be compared to the parameters of the standard model.

4722 **(RAL—87-037) Analysis of the highest transverse energy events seen in the UAl detector at the Spp-barS collider.** (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750220/JAW.

Submitted to Zeitschrift fuer Physik C.

The first full solid angle analysis is presented of large transverse energy events in pp-bar collisions at the CERN collider. Events with transverse energies in excess of 200 GeV at $\sqrt{s} = 630$ GeV are studied for any non-standard physics and quantitatively compared with expectations from perturbative QCD Monte Carlo models. A corrected differential cross section is presented. A detailed examination is made of jet profiles, event jet multiplicities and the fraction of the transverse energy carried by the two jets with the highest transverse jet energies. There is good agreement with standard theory for events with transverse energies up to the largest observed values (approx. $\sqrt{s}/2$) and the analysis shows no evidence for any non-QCD mechanism to account for the event characteristics.

4723 **(SI—86-6) Understanding mini-jets in the Dual Parton model.** Aurenche, P.; Bopp, F.W.; Ranft, J. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules; Siegen Univ. (Gesamthochschule) (Germany, F.R.); Karl-Marx-Universitaet, Leipzig (German Democratic Republic)). Aug 1986. 6p. (CONF-8606203—10). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900041/JAW.

From 17. international symposium on multiparticle dynamics; Seewinkel, Austria (13 Jun 1986).

The origin of transverse momenta in minimum bias events is investigated within the framework of the Dual-Parton model. It is concluded that the scattering process at SPS-COLLIDER energies has to contain a substantial "semihard" component. With an appropriate generalization of the original model one obtains a good description of the semihard features (connected to mini-jets) without effecting the general event structure well described before. 8 refs., 4 figs.

4724 Measurement of the properties of the eta/sup '/ and search for other resonances in $\gamma\gamma \rightarrow eta\pi^0\pi^0$. Antreasyan, D.; Bartels, H.W.; Besset, D.; Bieler, C.; Bienlein, J.K.; Bizzeti, A.; Bloom, E.D.; Brock, I.; Brockmueller, K.; Cabenda, R.; and others. (California Institute of Technology, Pasadena, California 91125). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2633-2640(1 Nov 1987).

The reaction $e^+e^- \rightarrow e^+e^-eta\pi^0\pi^0$ has been observed with the Crystal Ball detector at the DORIS II storage ring at DESY. The $eta\pi^0\pi^0$ mass spectrum is dominated by the eta', and the two-photon width Γ/sub eta//sub '//sub →//sub γ//sub γ/ is determined to be 4.6 +- 0.4 +- 0.6 keV. Limits on Γ/sub X//sub →// sub γ//sub γ/ x B/sub X//sub →//sub eta//sub π//sub π/ are given for other possible states.

4725 Measurement of the D^0 lifetime from the upgraded Mark II detector at the SLAC e^+e^- storage ring PEP. Wagner, S.R.; Hinshaw, D.A.; Ong, R.A.; Abrams, G.; Adolphsen, C.E.; Akerlof, C.; Alexander, J.P.; Alvarez, M.; Baden, A.R.; Ballam, J.; and others. (University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2850-2853(1 Nov 1987).

We present a new measurement of the D^0 meson lifetime based on 31 pb/sup -1/ of e^+e^- interaction data taken at $\sqrt{s} = 29$ GeV. The data were recorded with the upgraded Mark II detector, which allowed the identification of a clean D^0 signal from this small data set. Using a sample of 53 D^0 candidates based on the decays $D^0 \rightarrow K^-\pi^+$, $K^-\pi^+\pi^0$, and $K^-\pi^+\pi^-\pi^+$, we measure the D^0 lifetime to be 0.44/sub -0.11//sup +0.12/ +- 0.06 psec.

4726 Search for direct gamma production at low transverse momentum in 63-GeV pp collisions. Akesson, T.; Albrow, c.M.G.; Almehed, k.S.; Anassontzis, m.E.; Batley, l.R.; Benary, c.O.; Boggild, p.H.; Botner, f.O.; Breuker, f.H.; Burkert, c.V.; and others. (aBrookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2615-2623(1 Nov 1987).

We have searched for direct photons of low P/sub T/ (≦1.0 GeV/c) at θ/sub c.m./ = 90° in pp collisions at $\sqrt{s} = 63$ GeV. We used two independent methods: direct detection in NaI crystals and conversion to e^+e^- pairs. No signal is observed; the photon spectrum is well described by the decay of hadrons. The result is consistent with a direct low-P/sub T/ photon signal reported at $\sqrt{s} = 12$ GeV, but excludes a rapid growth of soft-photon production with $\sqrt{s}$.

4727 Tensor and vector spin observables in p-d elastic scattering at 600, 800, and 1000 MeV. Haji-Saied, M.; Bleszynski, E.; Bleszynski, M.; Carroll, J.; Igo, G.J.; Jaroszewicz, T.; Wang, A.T.M.; Sagle, A.; McClelland, J.B.; Morris, C.L.; and others. (Physics Department, University of California at Los Angeles, Los Angeles, California 90024). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2010-2017(Nov 1987).

Measurements of the tensor and vector spin observables C(0,NN,0,0), C(0,SS,0,0), and C(0,N,0,0), in p-d elastic scattering at 600, 800, and 1000 MeV equivalent proton bombarding energy, are reported. The data were taken in the range $0.1 < -t < 1.2$ $(GeV/c)^2$. The experiment employed a polarized deuteron beam with tensor and vector components of +- 0.75 and +- 0.25, respectively, a liquid hydrogen target, and a single arm magnetic spectrometer. The tensor and vector spin parameters C(0,N,0,0) and C(0,NN,0,0) were extracted from the data with beam polarization normal to the scattering plane. The observable C(0,SS,0,0) was obtained by precessing the deuteron polarization into the scattering plane. Comparison of the data with the predictions of a relativistic multiple scattering theory is made.

4728 Measurement of C/sub L//sub L/ and C/sub S//sub L/ in np elastic scattering at 484 and 634 MeV. Burleson, G.R.; Faucett, J.A.; Fontenla, C.A.; Garnett, R.W.; Rawool, M.W.; Ditzler, W.R.; Hill, D.; Hoftiezer, J.; Johnson, K.F.; Lopiano, D.; and others. (New Mexico State University, Las Cruces, New Mexico 88003). *Physical Review Letters;* **59**: No. 15, 1645-1648(12 Oct 1987).

The spin-spin correlation parameters C/sub L//sub L/ = (L,L;0,0) = A/sub L//sub L/ and C/sub S//sub L/ = (S,L;0,0) = A/sub S//sub L/ for np elastic scattering were measured for incident polarized-neutron—beam kinetic energies of 484 and 634 MeV over the center-of-mass angles from ≈80° to 180°. The data are important for determining the I = 0 nucleon-nucleon amplitudes. These results are compared with phase-shift calculations.

4729 Measurement of the decay tau→rhoν. Adler, J.; Becker, J.J.; Blaylock, G.T.; Bolton, T.; Brown, J.S.; Bunnell, K.O.; Burnett, T.H.; Cassell, R.E.; Coffman, D.; Cook, V. (California Institute of Technology, Pasadena, California 91125; University of California at Santa Cruz, Santa Cruz, California 95064; University of Illinois at Urbana-Champaign, Urbana, Illinois 61801; Stanford Linear Accelerator Center, Stanford, California 94305; University of Washington). *Physical Review Letters;* **59**: No. 14, 1527-1529(5 Oct 1987). Contract AC03-76SF00515.

The decay tau→rhoν is studied in tau pair production by e^+e^- annihilation at $\sqrt{s} = 3.77$ GeV, 0.20 GeV above tautau threshold. The branching fraction is measured to be B(tau→rhoν) = (23.0 +- 1.3 +- 1.7)%. The measured distribution of the helicity angle of the charged pion from the rho decay agrees with the theoretical prediction.

4730 Measurement of A/sub n//sub n/, A/sub n//sub o/, and A/sub o//sub n/ for the reaction $pp \rightarrow d\pi^+$ in the energy region 500—800 MeV. Tippens, W.B.; Bhatia, T.S.; Glass, G.; Hiebert, J.C.; Kenefick, R.A.; Northcliffe, L.C.; Boissevain, J.G.J.; Jarmer, J.J.; Simmons, J.E.; Fitzgerald, D.H. (Texas A & M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1413-1424(Oct 1987).

Angular distributions of the spin observables A/sub n//sub n/, A/sub n//sub o/, and A/sub o//sub n/ for the reaction $pp \rightarrow d\pi^+$ have been measured for pion c.m. angles $30° < \theta < 110°$ at beam kinetic energies of 500, 600, 650, 700, 733, and 800 MeV. These are precision data spanning the energy region of two conjectured dibaryon resonances in the NN system, one near 650 MeV ($^1D_2$) and one near 750 MeV ($^3F_3$). The A/sub n// sub n/ data have a significant impact on the partial-wave analyses and are in disagreement with the predictions of existing models. The data show no direct evidence for the existence of either of the two dibaryon resonances.

4731 EMC effect. Berger, E.L. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 165-184(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A review is presented of data and theoretical interpretations of the nuclear dependence of quark and antiquark distributions as observed in the deep inelastic scattering of neutrinos and charged leptons from nuclei. After a summary of the experimental situation and a survey of the broad spectrum of proposed explanations, I concentrate on the Q^2-rescaling approach and on interpratations, I concentrate on the Q^2-rescaling approach and on interpretations in terms of conventional nuclear physics. The review concludes with a list of desirable future experiments.

4732 Search for narrow lines in gamma spectra from p-barp annihilation at rest. Playfer, S.M. (Pennsylvania State University). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 458-459(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The gamma ray spectrum from p-barp annihilation at rest has been measured with good energy resolution and high statistics using a magnetic pair spectrometer. We find no narrow lines with widths comparable to the resolution. We obtain upper limits (90% C.L.) on the yield of narrow baryonium states of 2—5 x 10^{-4}/p-bar for states below 1700 MeV, and 5—10 x 10^{-4}/p-bar for states between 1700 and 1800 MeV.

4733 **Review of the physics of the neutrino.** Robertson, R.G.H. (Physics Division, Los Alamos National Laboratory, Los Alamos, NM 87545 U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 115-126(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The properties of neutrinos have been partially deduced in a series of elegant and difficult experiments spanning 50 years. Nevertheless, it seems more is unknown than known. Although the basic quantum propeties, such as spin, electric charge and helicity, are known, the extent and nature of lepton number conservation and the masses of the neutrinos are still largely open questions. A strong experimental and theoretical effort continues in neutrino oscillations, double beta decay, and neutrino mass measurement to try to illuminate some of these issues. In this review the current situation with specific regard to neutrino properties is considered, but not the wider field of neutrino interactions in general.

4734 **Storage ring magnet for a proposed new precision measurement of the muon anomalous magnetic moment.** Hughes, V.W. (J. W. Gibbs Laboratory, Physics, Dept. Yale University, New Haven, CT 06420). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 382-390(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief discussion is given of a proposed new precision measurement at the BNL AGS of muon g—2 at the level of 0.35 ppm which would represent an improvement by a factor of 20 over the famous CERN experiment. As at CERN a muon storage ring will be employed. This paper gives the parameters for the experiment and emphasizes features of the storage ring magnet and of the NMR system required to achieve the requisite precision of 0.1 ppm in the mean magnetic field.

4735 **LAMPF workshop on fundamental muon physics.** Hughes, V.W. (J. W. Gibbs Laboratory, Physics Department, Yale University, New Haven, CT 06520). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 575-581(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A Workshop on Fundamental Muon Physics: Atoms, Nuclei and Particles was held at LAMPF from January 20—22, 1986 with 85 physicists from Europe, Japan, Canada and the United States in attendance. Selected topics were examined where there is lively current interest and prospect for future advances, and included muon decay, muon capture, QED and electroweak interactions, laser spectroscopy of muonic atoms, high-energy muon-nucleon and muon-nucleus scattering, muon beams: new developments, and muon catalysis (see Table I). In this short review only the briefest comments on a few selected matters can be made.

4736 **Search for rare muon and pion decay modes with the crystal Box detector.** Piilonen, L.E.; Bolton, R.D.; Bowman, J.D.; Cooper, M.D.; Frank, J.S.; Hallin, A.L.; Heusi, P.; Hoffman, C.M.; Hogan, G.E.; Mariam, F.G.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 966-971(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

New experimental upper limits for the branching ratios of the lepton-family-number nonconserving decays $\mu^+ \rightarrow e^+\gamma$ and $\mu^+ \rightarrow e^+\gamma\gamma$ are presented. A new determination of γ, the ratio of pion axial-vector to vector form factors, from radiative pion decay is also reported. These results are from data taken with the Crystal Box detector at LAMPF.

4737 **Upper limit on the neutrino mass from the Los Alamos free molecular gaseous tritium experiment.** Knapp, D.A.; Bowles, T.J.; Maley, M.P.; Robertson, R.G.H.; Wilkerson, J.F. (Physics Division, Los Alamos National Laboratory, Los Alamos, NM 87544). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1031-1035(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The mass of the electron antineutrino can be determined by measurement of the shape of the beta spectrum of tritium near the 18.6 keV endpoint. A measurement of this spectrum has been undertaken at the Los Alamos National Laboratory, and initial results have been obtained, allowing an upper limit of 29.7 eV to be set on the neutrino mass.

4738 **Neutrino-oscillation experiments at reactors.** Greenwood, Z.D. (Physics Department, University of California, Irvine, CA 92717). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1042-1049(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A general review of neutrino-oscillation experiments at reactors is given. Preliminary results of two measurements at 18.2m and 23.7m from a production reactor at the Savannah River Plant are discussed.

4739 **Recent results on ν/sub e/ e$^-$ scattering.** Allen, R.C.; Bharadwaj, V.; Brooks, G.A.; Chen, H.H.; Doe, P.J.; Hausammann, R.; Lee, W.P.; Mahler, H.J.; Potter, M.E.; Rushton, A.M.; and others. (University of California, Irvine, California 92717). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1050-1055(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The latest results from the neutrino-electron elastic scattering experiment at the LAMPF beam stop are presented. Based on the data sample collected from September 1983 to December 1985, we observed 121 +- 25 events consistent with ν/sub χ/ e$^-$ scattering, of which 99 +- 25 events are assigned to ν/sub e/ e$^-$ scattering. The resulting cross section agrees with standard electroweak theory and rules out the constructive interference between weak charge-current and neutral-current interactions.

4740 **Antinucleon physics.** Dover, C.B. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 272-292(15 Oct 1986). (CONF-860575—). Contract AC02-76CH00016.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We review and interpret some of the recent data from LEAR, Brookhaven, and KEK on low and medium energy interactions of antinucleons (N-bar) with nucleons (N). Our emphasis is on elastic and charge exchange scattering, total cross sections, and studies of N-barN annihilation, with particular focus on the emerging evidence for broad resonances and/or bound states of the N-barN system and the selection rules which reveal the quark-gluon dynamics of the annihilation process.

4741 **Summary of the heavy ion physics sessions at Lake Louise.** Harris, J.W. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720 USA). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 318-324(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

This talk is a summary of the reports on heavy ion reactions which were given in this conference, Intersections Between Particle and Nuclear Physics . In particular, quark degrees of freedom in nuclear matter are a focus in these discussions of heavy ion physics.

4742 **Kaon decay session summary.** Schmidt, M.P. (Physics Department, Yale University, Box 6666, New Haven, Connecticut 06510). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 334-338(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A summary of the discussions on kaon decay which were given in the conference Interscetions Between Particle and Nuclear Physics is given. CP violation, hadron decay, semileptonic, and pure leptonic decays are included in this summary.

4743 **Use of the Fermilab antiproton source for experiments.** Griffin, J.E.; and Fermilab Antiprotn Source Dept. Members. (Fermilab, Box 500, Batavia, IL 60510, USA). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 391-394(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief description of the Fermilab antiproton source is presented. The primary purpose of this facility is to provide a bright source of antiprotons for p-barp physics in the TeV energy range (Fermilab Tevatron). During periods of scheduled Tevatron fixed target physics it will be possible to operate the antiproton source at reduced efficiency in a parasitic mode. During such periods it appears feasible to use the antiproton Accumulator Ring for low energy (below 8.9 GeV) antiproton experiments. One such program is outlined. An additioal small ring with good stored beam lifetime might possibly be operated in conjunction with the high energy p-barp program.

4744 **Measurement of the antineutron-proton annihilation cross section extremely close to the N-barN threshold.** Bassalleck, B. (University of New Mexico, Department of Physics and Astronomy, Albuquerque, NM 87131). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 445-448(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

In an experiment at the Brookhaven AGS n-barp annihilation has been studed very close to threshold, i.e. down to T-/sub n/ approx. <1 MeV. The antineutrons were produced by antiprotons via charge exchange p-barp→n-barn. The n-bar annihilation was detected in the same liquid hydrogen target in which they were produced. Very slow antineutrons were tagged by recording the associated, forward going neutron in a separate neutron time-of-flight detector. The n-barp annihilation cross section is extracted from the measured time dependence of the n-bar annihilation in the target. Preliminary results indicate values around β/sub n/—σ/sub A/≅35 mb (n-bar velocity * annihilation cross section).

4745 **Search for narrow states in antineutron-proton total and annihilation cross-sections near N-barN threshold.** Armstrong, T.; Chu, C.; Clement, J.; Elinon, C.; Furic, M.; Hartman, K.; Hicks, A.; Hungerford, E.; Kishimoto, T.; Kruk, J.; and others. (Department of Physics, The Pennsylvania State University, University Park, PA 16802, USA). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 460-467(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The n-barp total and annihilation cross sections have been measured from near N-barN threshold (1880 MeV) to 1940 MeV with RMS resolution ranging from 0.08 MeV (1880 MeV) to 6.7 MeV (1940 MeV). No significant narrow meson structures were seen, with 90% C.L. upper limits of 40—180 mb-MeV on σ/sub T/ for states with width less than our resolution. Combined with increasing unitarity bounds on σ as one approaches threshold, these limits confine widths of possible predicted states below 1900 MeV to less than ~1 MeV.

4746 **High p/sub T/ π0 production in $\alpha\alpha$, dd, and pp collisions at the CERN ISR.** BNL-CERN-Michigan State-Oxford-Rockefeller (BCMOR) Collatoration; Tanaka. (AGS Department, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 872-876(15 Oct 1986). (CONF-860575—). Contract AC02-76CH00016.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The invariant cross sections for inclusive high p/sub T/ π^0 production in $\alpha\alpha$, dd, and pp collisions have been measured in the central rapidity (y) region at the same center-of-mass energy per nucleon pair, $\sqrt{S}$/sub NN/ = 31 GeV. The transverse momentum range covers 3.5<p/sub T/<p/sub T/<9.0 GeV/c. The cross section ratio R ($\alpha\alpha$/pp) shows clearly the anomalous nuclear enhancement with <R> = 23.8+0.5 whereas the ratio R(dd/pp) shows no such enhancement and is roughly constant at <R> = 3.7+0.1. The data will be compared with theoretical predictions.

4747 **Future dibaryon research at BNL.** Pile, P.H. (Brookhaven National Laboratory, Upton, New York 11974). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 894-900(15 Oct 1986). (CONF-860575—). Contract AC02-76CH00016.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

An experiment designed to search for a strangeness -1 dibaryon is discussed. The experiment will use the ^{3}He (K^-, π^+)nD/sub s/ reaction and is expected to begin near the end of the year at the BNL AGS using the existing LESB-I beamline and hypernuclear spectrometer system. Planned searches for a strangeness -2 dibaryon are also discussed. The strangeness -2 dibaryon searches will however require the construction of a new 1.8 GeV/c kaon beam line at the AGS.

4748 **Polarized protons at the AGS and high P^2/sub perpendicular/ spin effects.** Roser, T. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, MI 48109). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1148-1152(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

At the AGS an intense polarized proton beam was for the first time successfully accelerated to 22 GeV/c, preserving a polarization of ~45%. Using this polarized beam a surprisingly strong energy dependence of the spin-spin correlation parameter A/sub n//sub n/ in high p^2/sub perpendicular/ elastic proton-proton scattering was discovered.

4749 **Spin effects in exclusive reactions at high p/sub perpendicular/.** Makdisi, Y. (AGS Department, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1166-1170(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Production and decay angular distributions from the process $\pi^- p \rightarrow rho^- p$ at 90° in the center-of-mass are presented. A large spin flip amplitude is observed, the ramifications of which are noted in the context of the known theories.

4750 **Spin observables in proton—neutron scattering at intermediate energy.** Spinka, H. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1171-1176(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A summary of np elastic scattering spin measurements at intermediate energy is given. Preliminary results from a LAMPF experiment to measure free neutron-proton elastic scattering spin-spin correlation parameters are presented. A longitudinally polarized proton target was used. These measurements are part of a program to determine the neutron—proton amplitudes in a model independent fashion at 500, 650, and 800 MeV. Some new proton-proton

total cross sections in pure helicity states (Δσ/sub L/(pp))= near 3 GeV/c are also given.

4751 **Parity violation in proton-proton scattering at intermediate energies.** Yuan, V.; Frauenfelder, H.; Harper, R.W.; Bowman, J.D.; Carlini, R.; MacArthur, D.W.; Mischke, R.E.; Nagle, D.E.; Talaga, R.L.; McDonald, A.B.; and others. (University of Illinois, Urbana, IL 61801). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1189-1193(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Results of a measurement of parity nonconservation in the p-arrow-right—p total cross section at 800-MeV are presented. The dependence of transmission on beam properties and correction for systematic errors are discussed. The measured longitudinal asymmetry is A/sub L/ = (+2.4 +- 1.1 (statistical +- 0.1 (systematic)) x 10^{-7}. A proposed experiment at 230 MeV is discussed.

4752 **Hadron-hadron colliders.** Tollestrup, A.V. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 168-204(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

A comparison between electron-positron and proton-antiproton colliders is used to initiate a discussion of current trends in hadron-hadron colliders. Specific accelerators (SSC, FFAG, ISR, SPS, and TeV I) are discussed. Also, current detection technology is discussed. (AIP)

4753 **Physics results of the UA1 collaboration at the CERN proton-antiproton collider.** Rubbia, C. (Harvard University CERN, Geneva, Switzerland). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 205-297(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

A detailed review of the findings of the UA1 collaboration at the CERN proton-antiproton collider yeilds physical characteristics of the intermediate vector bosons and the Z neutral boson. An extensive study of jets produced in the proton-antiproton collisions which is compared to QCD predictions is also given in this report. These experimental findings are in good agreement with standard SU(2)xU(1) models. (AIP)

4754 **Physics of e^+-e^- colliders: Present, future, and far future.** Peskin, M.E. (Stanford Linear, Accelerator Center, Stanford University, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 122-167(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

Positron-electron collider physics is presented in this article. Emphasis is placed upon current thought, experimental results, and accelerator technology. Directions for future accelerators, e.g., the SSC, and experiments are discussed. (AIP)

4755 **Fixed-target physics at Fermilab.** Bjorken, J.D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 144-158 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The Fermilab Energy Saver is now successfully commissioned and fixed-target experimentation at high energy (800 GeV) has begun. In addition, a number of new experiments designed to exploit the unique features of the Tevatron are yet to come on-line. In this paper the author reviews recent accomplishments in the fixed-target program and describes experiments in progress and others yet to come. While these experiments cover a diverse set of topics, they can be roughly categorized into the following groups: heavy quarks, lepton- induced processes, hard collisions and tests of QCD. There are, in addition, studies of weak decays and magnetic moments, and strong interaction studies using polarized beams of p and p-bar. The experiments in progress are classified into categories, which are tabulated in this paper.

4756 **Low energy tests for the standard model and beyond.** Rosen, S.P. (T-Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 171-191 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author reviews the general subject of tests of the standard model and searches for physics beyond the standard model in low energy processes. By "standard model", he means the product of gauge groups SU(3)/sub c/ x SU(2) x U(1) corresponding to Quantum Chromodynamics for strong interactions and the Glashow-Salam Weinberg model for electroweak interactions. Going beyond the standard model includes such ideas as grand unified theories with one gauge group for all interactions, composite Higgs particles and composite quarks and leptons, left-right symmetric models, and all other proposals which enlarge the minimal requirements of the standard model. Most of these ideas are tested at high-energy accelerators. Searches for proton decay, a major prediction of grand unified theories, do not require the use of accelerators at all; and the existence of Majorana neutrinos with non-vanishing masses, is best studied in a mixture of non-accelerator experiments and low-energy accelerator ones. The general subjects the author discusses include neutrino physics, precise measurements and searches for rare decay modes of the muon, CP violation and rare decay modes in Kaon physics, and proton decay.

4757 **The search for neutral leptons.** Perl, M.L. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 159-170 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Searches for new neutral leptons are reviewed. Some models for proposed neutral leptons are described. Methods used in past, present, and future searches are described. The limits obtained by some completed searches are given.

4758 **The SLAC linear collider.** Richter, B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 47-50 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A report is given on the goals and progress of the SLAC Linear Collider. The author discusses the status of the machine and the detectors and give an overview of the physics which can be done at this new facility. He also gives some ideas on how (and why) large linear colliders of the future should be built.

4759 **A search for $\mu \rightarrow e\gamma$.** Heusi, P.; Bolton, R.D.; Bowman, J.D.; Carlini, R.; Cooper, M.D.; Duong-Van, M.; Frank, J.S.; Hallin, A.L.; Hoffman, C.M.; Mariam, F.G. (Los Alamos Nat. Lab.). pp 274 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The decay $\mu \rightarrow e\gamma$, together with other neutrinoless muon decays, tests conservation of separate muon and electron lepton number and provides information about the validity of extensions to the standard GWS model of electroweak interactions. As part of the Crystal Box program at LAMPF, a sample of 2.2 x 10/sup 11/ stopped muons were examined to search for $\mu \rightarrow e\gamma$. This sample

has a sensitivity in the branching ratio for $\mu \rightarrow e\gamma$ of about 10/sup -10/. About 5000 of these events have more than 40 MeV energy deposited in the NaI for the electron and the photon, are coincident within 2.5 ns and have an opening angle larger than 160 degrees. Among these events were — 850 prompt events from the decay $\mu \rightarrow e\gamma\nu\nu$. The analysis of all the Crystal Box data accumulated so far, will have a sensitivity of about 10/sup -11/.

4760 **A search for supersymmetric electrons.** Le Claire, B.W. (SLAC, LBL, Harvard, for the Mark II Collaboration). pp 275-276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A search for single electrons from the decay of singly produced selectrons has been made at the PEP storage ring at SLAC. No events of this type have been found in 123 pb/sup -1/ of data, resulting in a cross section limit of less than 2.4 x 10/sup -2/ pb (at the 95% CL) within the detector acceptance. The previously published 95% confidence limit on the selectron mass of 22.2 GeV/c/sup 2/ for zero photino mass has been extended to include the effects of non-zero photino mass.

4761 **A new search for the rare decay: $\mu \rightarrow e\gamma\gamma$.** Grosnick, D.P.; Wright, S.C.; Bolton, R.D.; Bowman, J.D.; Carlini, R.; Cooper, M.D.; Duong-Van, M.; Frank, J.S.; Hallin, A.L.; Heusi, P. (Univ. of Chicago, Chicago, IL 60637). pp 237-238 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

This paper reports on a search for the family-number-violating decay, $\mu \rightarrow e\gamma\gamma$, using the Crystal Box detector at LAMPF. The new upper limit found for the branching ratio is B/sub $\mu e\gamma\gamma$/ < 3.8 x 10/sup -10/ (90% C.L.).

4762 **Recent progress in two photon physics.** Shen, B.C. (Univ. of California, Riverside, CA). pp 222-226 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A review of recent results in the study of two photon interactions is presented. Topics include total cross section, photon structure function, resonances, and exclusive processes.

4763 **Study of the decay psi' $\rightarrow \gamma\gamma \pi^0$/sup +/$\pi^0$/sup -/.** Ratoff, P.; Edwards, C.; Partridge, R.; Peck, C.; Porter, F.; Antreasyan, D.; Gu, Y.F.; Kollman, W.; Richardson, M.; Strauch, K. (Cal Tech). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Results are presented for psi' $\rightarrow \gamma\gamma \pi^0$/sup +/$\pi^0$/sup -/ from an analysis of 1.8x10/sup 6/ psi' events in the Crystal Ball detector at SPEAR. In this analysis, the authors search for the decays psi' $\rightarrow$ γeta' and psi' $\rightarrow$ rhoπ, and compare with corresponding decays of the J/psi.

4764 **Radiative decays of the psi' to low mass mesons.** Lee, R.; Gelphman, D.; Hofstadter, R.; Horisberger, R.; Kirkbride, I.; Kolanoski, H.; Konigsmann, K.; Liberman, A.; Litke, A.M.; O'Reilly, J. (Physics Dept. and HEPL, Stanford Univ.). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Using a sample of 1.8 x 10/sup 6/ psi's collected by the Crystal Ball detector at SPEAR, the authors have performed a study of the radiative decays of the psi' to the eta, eta', and f mesons. Branching ratios and upper limits are presented.

4765 **Electron-positron annihilation to two photons final state.** Wood, D. (Argonne National Lab.). pp 275 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A study of electron-positron annihilation to two-photon final state is done on 18.7 inverse picobarns of data at 29 GeV center-of-mass energy from PEP using the High Resolution Spectrometer. A total of 1600 events are observed with the barrel calorimeter which covers 60% of the solid angle. A lower limit on the mass of an excited electron is set by comparing the cross section of Bhabha scattering to the cross section of two photons in the final state.

4766 **Two- and three-pion production by ν/sub μ/D reactions near threshold: The implications for nucleon decay experiments.** Derrick, M.; Musgrave, B.; Ammar, R.; Day, D.; Gress, J.; Kafka, T.; Mann, W.A. (Argonne National Lab.). pp 386 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors use ν/sub μ/-deuteron reactions into exclusive multipion final states to determine the extent to which atmospheric ν interactions can imitate nucleon decay. For decays N $\rightarrow$ iota/sup C/π/sup C/π/sup C/ (iota/sup C/π/sup C/π/sup C/π^0), neutrinos induce background events at the rate 0.07 +- 0.06 (0.03 +- 0.02) per kiloton year. By requiring a multipion final state to be consistent with a rho, ω, or eta, a five-fold reduction of the background is obtained. Thus present-generation experiments are capable of searching for such decays at a lifetime level of many kiloton years corresponding to many kiloton years of detector exposure. Events containing a visible strange particle are also under analysis.

4767 **The Soudan 2 nucleon decay experiment.** Ayres, D.S. (Argonne National Lab.). pp 386 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The Soudan 2 detector is an 1100-ton fine-grained tracking calorimeter now being constructed to search for nucleon decay. It is distinguished by superior background rejection for a wide variety of decay modes. A cavity large enough for an eventual 3300 ton experiment is now being excavated 2000 ft underground in Minnesota's Soudan mine. The detector drifts ionization electrons inside 16-mm diameter resistive tubes onto readout planes of proportional wires and cathode strips. The tubes are arranged between 1.6-mm thick corrugated steel sheets in a honeycomb geometry. The self-triggering detector is assembled form 256 modules, and is 16-m x 8-m x 5-m. Data taking should begin in late 1985, with completion planned for 1987. Construction progress and the results of prototype tests are reported.

4768 **Inclusive π^0/sup o/ and non-strange meson production in νN interactions.** Koide, A. (Berkeley-FERMILAB-Hawaii-Seattle-Wisconsin collaboration (E546)). pp 274 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Inclusive π^0 production in neutrino-nucleon charged-current interactions is studied using a sample of events obtained from the Fermilab 15-ft bubble chamber filled with a moderate Neon-Hydrogen mixture. Neutral pion distributions in the hadronic variables x/sub F/, z, and rho/sub T/ are determined and shown to be similar to the corresponding charged pion distributions. The π^0 z distribution is also compared to π^0 results from other lepton induced interactions. These results give support to the apparent scaling violation observed in the higher energy e/sup +/e/sup -/ annihilation results. π^0's are also reconstructed individually and used to study non-strange resonance production. Inclusive event rates (with cuts) for the rho^0, rho/sup +/, rho/sup -/, ω, and eta mesons derived from this experiment are 0.25 +-0.03, 0.52 +- 0.11, 0.30 +- 0.08, 0.24 +- 0.07, and 0.19 +-0.06 respectively. The rho^0 z distribution for $z > 0.2$ is also presented and found to be consistent with other lepton scattering experiments.

4769 **The calculation of molecular final states and their effect on a precision neutrino mass experiment.** Fackler, O.; Sticker, H.; Mugge, M.; White, R.; Winter, N.; Woerner, R.; Kolos, W.; Jeziorski, B.; Szalewicz, K.; Monkhorst, H. (Rockefeller Univ.). pp 274 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

An experiment to determine the electron neutrino mass with the precision of a few eV by measuring the tritium beta decay distribution near the endpoint is being performed at the Lawrence Livermore National Laboratory. At the few eV level, a major consideration in the choice of a tritium source is the effect of excited final molecular states on the beta decay distribution. It is important to choose a source for which the initial and final states can be accurately calculated. The authors have chosen frozen tritium as their source since states of molecular tritium and those of the HeT/sup +/ daughter ion have molecular wavefunctions that can be calculated with high accuracy. They describe the effects of final excited states on the neutrino mass determination and the results of their calculations in this paper.

4770 **Electroweak effects in e/sup +/e/sup -/ $\rightarrow$ μ/sup +/μ/sup -/ at $\sqrt{s}$ = 29 GeV.** Sugano, K. (Argonne National Lab.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author has measured the differential cross sections for the e/sup +/e/sup -/ $\rightarrow$ μ/sup +/ μ/sup -/ process at $\sqrt{s}$ = 29 GeV, using the High Resolution Spectrometer at PEP. From the angular distribution based on 5057 μ/sup +/ μ/sup -/ events)=(total luminosity 106 pb/sup -1/[, he finds the charge asymmetry to be A/sub $\mu\mu$/ = (-4.9 +- 1.5 +- 0.5)%. The QED correction included in the above number is +1.6%. The absolute cross section based on the subsample of 3488 events in the angular range -0.55 $<\cos\theta <$ +0.55, gives a cross section ratio to the QED prediction of R/sub $\mu\mu$/ = 0.990 +- 0.017 +- 0.030. He measures the axial vector coupling and the vector coupling of the weal neutral current to be g/sup e//sub a/g/sup μ//sub a/ = 0.208 +- 0.064 +- 0.021 and g/sup e//sub v/g/sup μ//sub v/ = 0.027 +- 0.051 +- 0.089 respectively without weak radiative corrections. These numbers are consistent with the GSW standard model. The lower limits of the QED cutoff parameters are Λ/sub +/ > 170 GeV and Λ/sub -/ > 146 GeV with 95% CL.

4771 **Neutrino beam dump experiments at Fermilab.** Duffy, M.E.; Fanourakis, G.K.; Loveless, R.J.; Schumann, D.L.; Smith, E.S.; Childress, S.; Castoldi, C.; Conforto, G.; Ball, R.C.; Coffin, C.T. (Univ. of Wisconsin). pp 274 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Results from a study of prompt neutrino production in 400 GeV p-N collisions are presented in which little difference is observed between the ν-bar/sub μ/ and the ν/sub μ/ fluxes. Equality of the ν/sub μ/ and ν/sub e/ charged current fluxes is also found independent of the energy and transverse momentum of the neutrino. If only the DD productions is assumed, the cross section is σ = (17.2 +- 0.9 +- 1.5) (A/179)(1-x)/sup 3.2/e/sup -1.5p/t μb/nucleon. No differences are noted between the characteristics of charm production deduced from prompt neutrino production and those from prompt muon production. Results on the A dependence of the prompt ν flux are presented.

4772 **High Z quark fragmentation.** Price, L.E. (Argonne National Lab.). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Invariant differential cross-sections for charged and neutral π and K meson production have been measured in an 86 pb/sup -1/ data sample of 29 GeV e/sup +/e/sup -/ annihilation events from the High Resolution Spectrometer at PEP. These are interpreted as quark fragmentation functions. The inclusive distributions for charged mesons (π/sup +-/, K/sup +-/) and for π^0 show two slopes, falling as (1 - z)/sup 3/ between $0.2 < z < 0.6$, and for $z >$ 0.6 showing the (1 - z)/sup 2/ behavior expected from the first-order fragmentation process. There is no evidence of the constant term that would indicate a higher-twist contribution.

4773 **A production in the HRS at PEP.** Baringer, P. (Indiana Univ.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Production cross sections for the Λ and Λ-bar particles are obtained from 106 inverse pico-barns of electron-positron annihilation data taken at 29 GeV center-of-mass energy by the High Resolution Spectrometer at PEP. Differential cross sections are given as a function of momentum, fractional energy, rapidity, transverse momentum, and the lab production angle. Measurements of an asymmetry in the lab production angle of the Λ and of the Λ polarization are presented. Finally, variations in the Λ cross section with respect to the sphericity of the event, and with respect to the mass of the jet containing the Λ are investigated.

4774 **Observation of F(1975) in e/sup +/e/sup -/ annihilation at 29 GeV.** Beltrami, I. (Purdue Univ.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A 106 pb/sup -1/ data sample from the High Resolution Spectrometer at PEP provides preliminary data on inclusive production of Phi-mesons and the F/sup +-/(1975) decaying into Phiπ/sup +-/. The fragmentation functions D(z), where $z = 2 \cdot E/\sqrt{s}$, and cross sections are measured and compared to existing data. The fragmentation function for the F(1975) is observed to peak near z = 0.25, implying that the production mechanism of the F at these energies is not dominated by primary charmed quarks. Production and decay angular distributions of the F are also presented. An F mass of 19175 /sup +-/ 4 MeV/c/sup 2/ has been measured.

4775 **Evidence for the F/sup */ meson.** Enomoto, R. (Univ. of Tokyo). pp 277-278 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Evidence for a narrow state decaying into a F meson and a photon has been obtained in e/sup +/e/sup -/ annihilation events at 29 GeV c.m. energy. This state lies 139.5 +- 8.3(stat) +- 9.7(syst) MeV above the F meson mass and is consistent with the expected F/sup */ meson. The F mesons are identified by a peak in the K/sup +/K/sup -/π/sup +-/ mass at 1.948 +- 0.028 +- 0.010 GeV.

4776 **Charmed baryon production in e/sup +/e/sup -/ annihilation in the upsilon region.** Mestayer, M.D. (Vanderbilt Univ.). pp 278 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author has observed the production of Λ/sub c/ baryons in e/sup +/e/sup -/ annihilation by reconstructing their mass from the decay mode Λ/sub c/ $\rightarrow \Lambda\pi$/sup +/π/sup +/π/sup -/. They compare the production rates of the Λ/sub c/ with that of the D/sup +/ meson, which they detect through its K-bar$^0\pi$/sup +/π/sup +/π/sup -/ decay mode. The similarity of the kinematics of the two decays implies that much of the systematic uncertainty in detection efficiency cancels in the ratio of the rates, thereby allowing a comparison of charmed baryon and meson hardonization.

4777 **Semileptonic decays of B mesons.** Csorna, S.E.; Garren, L.; Hood, D.; Panvini, R.S.; Word, G. (Vanderbilt Univ.). pp 278 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have studied semileptonic B meson decays associated with the T(4s) bb-bar resonance. This data was obtained with the CLEO detector at CESR. These studies deal with the decay $B^0 \rightarrow D^* +$ iota $+ \nu$ and include the following: the D*/(D + D*) ratio, the D* momentum spectrum, D*-iota correlations and a measure of the weak decay matrix element. In addition, common features of non-leptonic and semi-leptonic decays are discussed.

4778 **Selected topics from J/psi decays.** Odian, A. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 198-200 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—). Contract AC03-76SF00515.

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The topics the author covers are: 1. The iota spin parity 2. The θ spin parity 3. Conclusions.

4779 **A new limit on the oscillation between ν/sub μ/ and ν/sub e/.** Suzuki, Y. (Osaka Univ., Toyonaka, Osaka 560). pp 257 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Measurements have been made of the reactions ν/sub e/n $\rightarrow$ e/sup -/p and ν/sub μ/n $\rightarrow \mu$/sup -/p by wide band neutrino beam in a detector/sup 1/ located an effective distance of 96m from a neutrino source. No evidence for the oscillation ν/sub μ/ $\rightarrow \nu$/sub e/ is found.

4780 **Observation of upward-going muons and limits on neutrino oscillations from the IMB detector.** Bionta, R.; Blewitt, G.; Bratton, C.B.; Casper, D.; Chrysicopolou, P.; Claus, R.; Cortez, B.G.; Errede, S.; Foster, G.W.; Gajewski, W. (Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109). pp 255-256 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A 313 day measurement of the flux of upward, through-going muons has been conducted using the IMB proton lifetime detector. The authors' measured flux of (15.2 +- 1.4) x 10/sup -13/μ/(cm/sup 2/ s) is consistent with expectations from atmospheric neutrino spectra. By comparing the measured and expected fluxes, they set flux-dependent 90% C.L. limits in Δm/sup 2/-sin/sup 2/ 2α parameter space for any disappearance of atmospheric ν/sub μ/ through oscillation ν/sub μ/$\rightarrow\nu$/sub x/. For sin/sup 2/ 2α=1, our limit is Δm/sup 2/ $<$ 3 x 10/sup -4/(eV)/sup 2/.

4781 **Observation of strangeness correlations in meson and baryon pair production in e/sup +/e/sup -/ annihilation at $\sqrt{s}$ = 29 GeV.** Yamamoto, H. (Lawrence Berkeley Lab.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Correlations in rapidity space are presented for pion and kaon pairs. Short range KK correlations indicate local flavor compensation. Long range KK and $\pi\pi$ correlations prove that the initial partons carry flavor. Significant Kπ correlations are the result of heavy quark decays. Also, the author has observed for the first time $\Lambda\Lambda$-bar pairs in jets. He used these data to study flavor correlation in baryon production. The flavor correlation between the baryon and the antibaryon of a baryon pair has been found to be weak.

4782 **Vector meson production in e/sup +/e/sup -/ annihilation at E/sub cm/ = 29 GeV in the high resolution spectrometer.** Kooijman, P. (Argonne National Lab.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Vector meson production cross sections in e/sup +/e/sup -/ collisions at W = 29 GeV have been measured using a data sample corresponding to an integrated luminosity of 106 pb/sup -1/ taken with the High Resolution Spectrometer. Total and differential cross sections are reported for K/sup */ (890)/sup +-/, K/sup */ (890)^0, and rho^0. Comparisons are made with K^0 and π^0 cross sections.

4783 **Electrons from heavy quark decay in e/sup +/e/sup -/ annihilation at Ecm = 29 GeV in the high resolution spectrometer.** Trinko, T. (Univ. of Michigan). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Electrons from B meson decay have been observed and the B meson semi-leptonic branching ratio measured using a data sample corresponding to an integrated luminosity of 106 pb/sup -1/ taken with the High resolution Spectrometer. An upper limit for the cross section for psi $\rightarrow$ e/sup +/e/sup -/ has also been measured.

4784 **Charged particle production in e/sup +/e/sup -/ annihilations at $\sqrt{s}$ = 29 GeV.** Ranagan, L.K. (Purdue Univ.). pp 277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Production cross sections for π/sup +-/, K/sup +-/, p and p-bar in e/sup +/e/sup -/ annihilations at $\sqrt{s}$ = 29 GeV have been measured with the High Resolution Spectrometer (HRS) at PEP. The time-of-flight was used to calculate a mass-squared value for a charged particle. The mass-squared distributions in seven momentum ranges between 0.5 and 1.9 GeV/c have been fitted with three gaussians representing the three particle species. The areas under these gaussians have been converted to cross sections. With increasing momentum, the π/sup +-/ fraction decreases and both the K/sup +-/ and p, p-bar fractions increase. The HRS K/sup +-/ fraction and cross section for momenta less than 1 GeV/c are lower than those of TASSO at PETRA ($\sqrt{s}$ = 22 and 34 GeV). Otherwise, the fractions and cross sections are consistent with TPC at PEP and TASSO.

4785 **Charged particle multiplicities of heavy quark jets.** Rowson, P.C. (Harvard Univ.). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The charged particle multiplicities of hadronic events corresponding to produced bottom or charm have been measured in the MARK II detector at the cms energy of 29 GeV. Flavor enrichment is accomplished by tagging with prompt lepton secondaries. Existing measurements of decay multiplicities for bottom or charmed mesons are used to extract the multiplicities of the non-leading particles produced accompanying a pair of heavy quarks: 5.8 +- 0.6 +- 0.7 for bottom, and 8.3 +- 0.7 +- 0.8 for charm.

4786 **Jet production and fragmentation in e/sup +/e/sup +/ annihilation at 29 GeV.** Valdata-Nappi, M. (Indiana Univ.). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The general properties of jets produced in e/sup +/e/sup -/ annihilation are discussed. Multiplicities, rapidity correlations and jets fragmentation properties are studied for both the total one photon annihilation sample and for an enriched sample of two jet events, at a cm energy of 29 GeV. The data were obtained with the High Resolution Spectrometer at the PEP e/sup +/e/sup -/ colliding beam facility. The results correspond to an integrated luminosity of 106 pb/sup -/.

4787 **Study of tau production and decay in e/sup +/e/sup -/ collisions at 29 GeV cm.** Gan, K.K. (Purdue Univ.). pp 275 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Using a data sample of 106 pb/sup -1/, the tau pair production is compared with the predictions of QED and the standard model of electroweak interactions. Limits on QED cutoff parameters are given. The cross section, charge asymmetry and the 1,3 and 5 charged particle branching ratio in the tau decay are reported.

4788 **Study of the decay tau/sup +-/→π/sup +-/π/sup +/π/sup -/ν at PEP.** Abrams, G.S.; Matteuzzi, C.; Schmidke, W. (Harvard Univ.). pp 275 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The reaction e/sup +/e/sup -/ → tau/sup +/tau/sup -/ at a center of mass energy of 29 GeV has been studied using the Mark II detector. The three-charged-prong decays of the tau yield a relatively clean sample of the decay tau/sup +-/ →π/sup +-/ π/sup +/ π/sup -/ ν/sub tau/. These events are dominated by the rho°π/sup +-/ intermediate state. A Dalitz plot analysis confirms the expected dominance of the $\int$/sup p/ = 1/sup +/ S-wave rhoπ amplitude. An S-wave Breit-Wigner fit to the rhoπ mass distribution yields a mass of 1.1 GeV/c/sup 2/ and a width of 0.5 GeV/c/sup 2/.

4789 **Like sign dilepton results in the 15-ft bubble chamber.** Schaffer, A.C.; Baltay, C.; Bregman, M.; Caroumbalis, D.; Chen, L.D.; Hibbs, M.; Liu, J.T.; Okamitsu, J.; Ormazabal, G.; Shastri, K. (Columbia Univ.). pp 274-275 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors report on a search for ν/sub μ/+N→μ/sup -/+e/sup -/+X events in their most recent wide band neutrino run at Fermilab. This run in the 15 ft bubble chamber with a heavy neon mixture had useful EMI data. A number of events are seen. They discuss the possible sources of background and final results are given.

4790 **Limits on tau composite structure from polarized Z^0 decay.** Reid, J.; Samuel, M.; Milton, K.A.; Rizzo, T.G. (Oklahoma State Univ.). pp 351 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors extend the recent analysis of Silverman and Shaw on limits of possible composite structure of the tau to the case where the tau's result from polarized Z^0 decay. They allow for both anomalous-magnetic-moment (κ/sub ν/) and CP-violating electric-dipole-moment (κ/sub A/) couplings of the tau's to the Z^0. With a Z^0 factory and longitudinally polarized e/sup +-/ beams it may be possible to set limits on κ/sub A/ and κ/sub ν/ at the 10/sup -3/ level.

4791 **Tests of models for quark and gluon fragmentation in e/sup +/e/sup -/ annihilation at $\sqrt{s}$ = 29 GeV.** Gary, J.W. (Lawrence Berkeley Lab.). pp 276-277 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Particle distributions in 3-jet events are presented for data collected with the Time Projection Chamber (TPC) at PEP. The particle density between jets is compared with the predictions of three fragmentation models currently in use: the Lund string model, the Webber QCD model and an independent fragmentation model (IF). The results indicate that the IF model is unable to describe the data, while the Lund string model provides a good description. The Webber QCD model, which is untuned, does not describe the absolute particle densities but provides a good description of the ratios of those densities, which are less sensitive to the tuning.

4792 **Comparison of light quark and charm quark fragmentation.** Kesten, P. (Univ. of Michigan). pp 276 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Separate samples of charm quark and light quark (u,d,s) jets have been isolated from an experiment studying e/sup +/e/sup -/ annihilations at 29 GeV. Although the two data sets show differences in the charged multiplicities, in the momentum distributions, and in rapidity, the gluon fraction is the same, supporting flavor independence of the quark gluon coupling. The rapidity distributions for both samples show a dip at zero in contrast to data from hadron beam jets.

4793 **Interpretation of anomalous pp-bar collider events.** Barger, V. (Dept. of Physics, Univ. of Wisconsin, Madison, WI 53706). pp 398-401 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The predictions of three supersymmetry scenarios for the UAl monojet events are described. Alternative models for Z → iotaiota-bary events lead to improbable Dalitz plot distributions. Some single heavy particle production models for anomalous collider events are ruled out by unitarity constraints.

4794 **Implications for supersymmetry of the CERN monojets.** Haber, H.E. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 390-393 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Results of a comprehensive study of supersymmetric processes which could give monojet events similar to those observed at the CERN Spp-barS are presented. If supersymmetry is to be the explanation of the monojets, strict bounds are obtained on possible supersymmetric masses.

4795 **A determination of the nucleon structure using the weak neutral current.** Bogert, D.; Burnstein, R.; Fisk, R.; Fuess, S.; Morfin, J.; Ohska, T.; Stutte, L.; Walker, J.K.; Bofill, J.; Busza, W. (Fermi National Accelerator Lab.). pp 263-265 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

An experimental determination of the neutral current structure functions of the nucleon is made from the ratio of the neutral current x distribution to the charged current x distribution. The analysis is based on a measurement of deep inelastic neutrino scattering data gathered in a massive fine-grained neutrino detector exposed to a narrow band neutrino beam at Fermilab.

4796 **Encounter on the bus.** Goldhaber, G. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. Dept. of Physics). pp 103-105 of From SU(3) to gravity. Festschrift in honor of Yuval Ne'eman. Gotsman, E.; Tauber, G. (eds.). Cambridge, GB; Cambridge University Press (1985).

The first meeting between the author and Yuval Ne'eman was on a bus in Geneva in 1962. At this time Yuval Ne'eman had arrived at a classification scheme for particles and resonances essentially equivalent to the one Murray Gell-Mann had arrived at and called the 'Eightfold Way'. The theories, experiments and people involved with these important discoveries of particle physics in the early 1960's are chronicled by the author. These include K^+ interactions which did not lead, as expected, to hyperon resonances. This fact was incorporated into Ne'eman's theory and led to the conclusion that the delta decouplet must exist.

4797 **Crystal Box: Rare decays of the muon.** Bolton, R.; Carlini, R.; Bowman, J.; Cooper, M.; Hallin, A.; Frank, J.; Hoffman, C.; Matis, H.; Mischke, R.; Nagle, D.; and others. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 242-243(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

Development of the Crystal Box Spectrometer at the Clinton P. Anderson Meson Physics Facility in Los Alamos has been completed. And a search for the rare muon decays mu to e-gamma, to e-2gamma, and to 3e is ready to start taking data. (AIP)

4798 **Studies of symmetry violations with kaons at Brookhaven.** Schmidt, M.P. (Yale University, New Haven, Connecticut). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 273-280(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

A review of the Yale-Brookhaven collaboration's experimental program on "low energy" tests of conservation laws is presented. In particular, studies of CP violating kaon decays are discussed. (AIP)

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 4692, 4694, 4698, 4700, 4718, 4723, 4733, 4735, 4741, 4742, 4756, 4757, 4770, 4787, 4790, 4791, 4888, 4893, 4893, 4895, 4930, 4931, 4942, 4944, 4946, 4951, 4952, 5079, 5101, 5108, 5110, 5114, 5114, 5188, 5331

4799 **(CEA-CONF—8845) Vector mesons and QCD.** Chemtob, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Oct 1986. 24p. (CEA-SPHT—86-150; CONF-8609329—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753241/JAW.

From Workshop on meson photoproduction and electroproduction on nucleon and nuclei; Lyon, France (29 Sep 1986).

We review the phenomenology of vector mesons in the context of the effective Lagrangian skyrmion-baryon approach. 56 refs.

4800 **(CEA-CONF—8966) Skyrmions and anomalies.** Rho, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Feb 1987. 19p. (CEA-SPhT—87-37; CONF-870280—Summs.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750488/JAW.

From Workshop on skyrmions and anomalies; Krakow, Poland (20 Feb 1987).

The author summarizes the works presented at the meeting on Skyrmions and anomalies. He divides the principal issues of this workshop into five categories: QCD effective Lagrangians, chiral bags and the Cheshire cat principle, strangeness problem, phenomenology, mathematical structure.

4801 **(DOE/ER/05490—84) Research in elementary particle physics: Progress report, March 1, 1987 to February 28, 1988.** Chan, Lai-Him, Haymaker, R.; Imlay, R.; Metcalf, W. (Louisiana State Univ., Baton Rouge (USA)). 1987. Contract AS05-77ER05490. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002130/JAW.

We describe theoretical work on effective action expansion on an effective low energy theory of hadrons, dynamical symmetry breaking, and lattice gauge theories. The high energy experimental group at Louisiana State University is taking data on a neutrino oscillation experiment at LAMPF. Analysis is in progress. LSU is also participating on an electron-positron experiment, AMY, that is running at TRISTAN in Japan. LSU is responsible for the muon

detector for AMY. We are analyzing a 5 pb^{-1} data obtained in the summer of 1987. Preliminary results have been presented at conferences and one paper has been submitted for publication.

4802 **(DOE/ER/40150—3-Rev.) Perturbative QCD and electromagnetic form factors.** Carlson, C.E.; Gross, F. (College of William and Mary, Williamsburg, VA (USA). Dept. of Physics; Lund Univ. (Sweden). Dept. of Theoretical Physics; Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 35p. (CEBAF-PR—85-005-Rev.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001717/JAW.

We calculate nucleon magnetic form factors using perturbative QCD for several distribution amplitudes including a general one given in terms of Appell polynomials. We find that the magnitude and sign of both nucleon magnetic form factors can be explained within perturbative QCD. The observed normalization of G/sub Mp/ requires that the distribution amplitude be broader than its superhigh momentum transfer limit, and the G/sub Mn//G/sub Mp/ data may require the distribution amplitude to be asymmetric, in accord with distribution amplitudes derived from QCD sum rules. Some speculation as to how an asymmetric distribution amplitude can come about is offered. Finally, we show that the soft contributions corresponding to the particular distribution amplitudes we use need not be bigger than the data. 16 refs., 6 figs.

4803 **(DOE/ER/40150—37) p(e-vector,e)p.** Pollock, S.J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). Dec 1986. Contract AC05-84ER40150. 20p. (CEBAF-PR—86-015; CONF-861277—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001721/JAW.

From Parity violation workshop - CEBAF; Newport News, VA, USA (11 Dec 1986).

We present calculations of the parity violating asymmetry in elastic electron proton scattering. Our goal is to find means to measure the nucleon weak form factors. Such measurements will provide interesting tests of the standard model in a strongly bound regime, as well as revealing details of the proton's weak structure. In addition, by assuming the standard model, we produce numerical predictions for the asymmetry.

4804 **(EFI—869-20-86) PA -> λ/sub c/(D)x processes in the leading hadron model.** Zhamkochyan, V.M. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700311/JAW.

Charmed hadron production on nuclei in a wide energy range of incident protons (0.4 - 150 TeV) is considered. In the framework of the leading hadron multiple interactions model, using the methods of multiple scattering theory, the parameters of the A-dependence of the effective nucleon numbers are predicted which correspond to differential cross sections of pA -> Λ/sub c/(D)x processes. 16 refs.; 2 figs.

4805 **(EFI—882-33-86) Relativistic effects in V -> H deg γ decay.** Aznauryan, I.G.; Grigoryan, S.G.; Matinyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700315/JAW.

The influence of the relativistic effects on the width of V->H/sup 0/γ radiative decay is investigated. These effects are shown to decrease essentially the value of this width given by nonrelativistic quark model. 10 refs.; 2 figs.

4806 **(EFI—903-54-86) Quark-gluon mixing in pseudoscalar and tensor mesons.** Eremyan, Sh.S.; Nazaryan, A.E. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700319/JAW.

A mixing model of quark-antiquark ang gluonium states in eta, eta', i(1440) pseudoscalar and f, f', Θ(1640) tensor mesons is considered. Description of and predictions for 68 two-particle decays with these particles taking part in them are obtained. It is shown that i(1440) by 85% consists of gluonium and Θ(1640) is a pure gluonic state. The quark-gluon and gluon-gluon couplings in the pseudoscalar sector are obtained to be stronger as compared to the corresponding ones in the tensor case. 26 refs.; 3 tabs.; 1 fig.

4807 **(GSI—87-32-Prepr.) Phase transition from hadron gas to quark gluon plasma - influence of the stiffness of the nuclear equation of state.** Rischke, D.H.; Stoecker, H.; Greiner, W.; Friman, B.L. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Jun 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750173/JAW.

We present a thermodynamically consistent treatment of a density-dependent interaction energy in hadronic matter in a mean-field approximation. With a phenomenological ansatz for this interaction energy we investigate the phase transition between hadronic matter and a quark gluon plasma. We find a strong influence of the stiffness of the nuclear equation of state on the phase transition. The bombarding energies necessary to establish a hadron-to-quark-matter transition are estimated in a one-dimensional hydrodynamical model.

4808 **(HD-PY—87/07) New's on the U's.** Heintze, J. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). 1987. 9p. (CONF-870334—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750167/JAW.

From Workshop on results and perspectives in particle physics; La Thuile, Italy (1 Mar 1987).

In the last year the CERN hyperon beam collaboration WA62 reported evidence for narrow exotic states U(3100) decaying into Λanti p + pions. A possible interpretation of these states was diquonium (qq anti qanti q). Preliminary results from the BIS-2 collaboration (Serpukhov) apparently confirm the WA62 result. Recently, Chan and Tsou pointed out that specific predictions for such states were made 10 years ago assuming rotational levels of M-diquonium. It is shown that the experimental data of WA62 indeed exhibit the predicted properties to some extent. Although no definite conclusion is possible at this moment, one can expect that the new hyperon beam experiment we are presently preparing will lead to a rich and beautiful spectroscopy of a new type of hadronic matter.

4809 **(HD-PY—87/08) Is the U(3100) strange diquonium?.** Siebert, H.W. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). 1987. 6p. (CONF-8704177—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750166/JAW.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

The author discusses the possible quark structure of an exotic resonance observed in the WA62 experiment at CERN. Especially its decay is considered and proposals are made for future experiments. (HSI).

4810 **(IFT-P—16/87) 2ω Dimensional light-cone integrals with momentum shift.** Suzuki, A.T. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700364/JAW.

A class of light-cone integrals typical to one-loop calculations in the two-component formalism is considered. One finds type of integrals in the evaluation of one-loop diagrams, such as the 'swordfish' diagrams. The results cannot be expressed as a finite sum of elementary functions, but convergence is verified for the particular cases considered. (G.D.F.).

4811 **(IFT-P—18/87) One-loop three-gluon vertex and power counting in the light-cone gauge.** Suzuki, A.T. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700365/JAW.

The divergent part of the one-loop three-gluon vertex is evaluated in the framework of the two-component formalism for the light-cone gauge. The result is consistent with multiplicative renormalizability for pure Yang-Mills gauge theories. Explicit cal-

culation of the 'swordfish' and triangle diagrams of these theories has shown that the characteristic light-cone integrals do not contribute to the relevant pole parts of these diagrams. The Mandelstam prescription implemented via dimensional regularization is employed to regulate Feynman integrals. (G.D.F.).

4812 (IFVE-ONF—86-118) **Reconstruction of the π/sup 0/-meson spectra using regularization method.** Myagkov, A.G.; Sokolov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700382/JAW.

The reconstruction of some π/sup 0/-mesons spectra have been discussed. The relations for lepton-hadron interactions between z- and x/sub F/-distribution of π/sup 0/-mesons (where z-part of hadron system energy carried away by π/sup 0/ mesons x/sub F/-Feynman variable) and observed spectra of γ-quanta have been obtained. The method of equation solution have been considered. 5 refs.

4813 (INIS-mf—10996, pp 8-12) **Antiproton-proton annihilation at rest (Asterix experiment at lear facility at Cern).** Botlo, M.; Lan, C.; Vonach, H. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4814 (INIS-mf—11041, pp 191-196) **Gluon jets.** Orava, R.; Sairanen, K. (Helsinki Univ., Finland. Dept. of High Energy Physics). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

We utilize experimental data on hadronic decays of T(1S) to evaluate the gluon fragmentation function. Our result indicates that gluon hadronization produces more soft hadrons than quark fragmentation.

4815 (INIS-mf—11041, pp 511-527) **Diquarks.** Fredriksson, S. (Royal Inst. of Tech., Stockholm, Sweden). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The particular diquark model developed in Stockholm by Svante Ekelin, Magnus Jaendel, Tomas I. Larsson and myself is presented. It has implications for many corners of high-energy physics. In particular deep-inelastic lepton-nucleon scattering, e/sup +/e/sup -/ annihilation and diquark fragmentation are discussed.

4816 (INIS-mf—11041, pp 539-545) **Recent progress in the bag model.** Mankiewicz, L. (Polska Akademia Nauk, Warsaw. Centrum Astronomiczne). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Some corrections to the standard MIT bag model such as the center of mass motion correction and the chiral pion cloud correction are discussed. (M.F.W.).

4817 (INIS-mf—11041, pp 565-567) **Four fermion condensates and the Higgs phenomenon (on the lattice).** Lacaze, R.; Napoly, O. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Service de Physique Theorique). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

4818 (INIS-mf—11041, pp 73-78) **Supersymmetric decay modes of the W and single electron production in pp collision.** Barbieri, R.; Cabibbo, N.; Maiani, L.; Petrarca, S. (Pisa Univ., Italy. Ist. di Fisica; Rome Univ., Italy. Ist. di Fisica). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The results of a work, in which the possibility of detecting the supersymmetric decay mode of W+- in pp-bar collisions was analysed, are presented. (M.F.W.).

4819 (INIS-mf—11041, pp 445-455) **Why do we need better measurements of sin/sup 2/ θ, rho and gauge boson masses?.** Olechowski, M.; Pokorski, S. (Warsaw Univ., Poland. Inst. Fizyki Teoretycznej). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Sensitivity of low energy weak parameters to possible new mass scales is discussed within SU(2) x SU(2) x U(1) models and SO(10) unification. Accuracy better than 0,5% is needed for meaningful tests of the standard model in region up to 1 TeV and of the SU(5) prediction for sin/sup 2/ θ.

4820 (INIS-mf—11041, pp 569-594) **Weak gauge bosons: an introduction.** Sorba, P. (Grenoble-1 Univ., 74 - Annecy, France. Lab. de Physique des Particules). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The main properties of the weak vector bosons in the SU(2) x U(1) gauge model are presented. The different types of production of gauge bosons are compared. In particular physics of W and Z in pp and pp-bar collisions is discussed. (M.F.W.).

4821 (INIS-mf—11041, pp 595-621) **Renormalized parameters of the elektroweak theory.** Paschos, E.A. (Dortmund Univ., Germany, F.R. Inst. fuer Physik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The status of determining several parameters of the electroweak theory including one-loop radiative corrections is presented. Restrictions on the flavor mixing matrix, under the assumption that the lifetime of the B meson is larger than 0.3 x 10/sup -12/ sec are discussed.

4822 (INIS-mf—11041, pp 623) **Factorization and soft gluons in the Drell-Yan process.** Soper, D. (Oregon Univ., Eugene, USA. Inst. of Theoretical Physics; European Organization for Nuclear Research, Geneva, Switzerland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

4823 (INIS-mf—11041, pp 167-176) **K-factors in the deep inelastic Compton and Drell-Yan processes.** Czechowski, A.; Krawczyk, M. (Warsaw Univ., Poland. Inst. Fizyki Teoretycznej). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The associated production of hadrons is used to answer the question about the nature of large QCD corrections for hard processes. The results of the order α/sub s/ calculation of K-factors for the deep inelastic Compton process and some predictions for the large p perpendicular to Drell-Yan pair production in hadron-hadron collision are presented. In the soft gluon approximation a

significant difference between K-factors corresponding to different inclusive distributions in each of these processes is found.

4824 (INIS-mf—11041, pp 177-189) **Low p/sub T/ physics at the SPS collider.** Capella, A. (Paris-11 Univ., 91 - Orsay, France. Lab. de Physique Theorique et Hautes Energies). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The low p/sub T/ results obtained at the CERN SPS collider are compared with the predictions of the dual parton model.

4825 (INIS-mf—11041, pp 229-242) **Phenomenological expectations on high-energy hadron-hadron scattering from asymptotic theorems.** Fischer, J. (Centre National de la Recherche Scientifique, 13 - Marseille, France. Centre de Physique Theorique; Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The consequences of analyticity, crossing symmetry and unitarity are discussed in connection with experiments on pp and p-barp scattering. A work is reported in which the model of geometrical scaling was used to predict the evolution of the diffractive dip in pp and p-barp scattering with increasing energy. In the collider energy range, the model predicts a full and a partial vanishing of the diffractive dip in $d\sigma/dt$ of the pp and p-barp scattering, respectively, at still higher energies, the dip develops again to its full reapparance at asymptotic energy.

4826 (INIS-mf—11041, pp 243-247) **Analyticity and QCD pion form factor.** Dubnicka, S.; Mojzis, M. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav; Komenskeho Univ., Bratislava, Czechoslovakia). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

It is shown that the combination of the analyticity with the perturbative QCD pion form factor asymptotic behaviour in the space-like region provides a model independent result for the Im F/sub π/(Q/sup 2/) at least at the asymptotic region for t-> + ∞. (M.F.W.).

4827 (INIS-mf—11041, pp 249-256) **Exclusive radiative quarkonium decays.** Kuehn, J. H. (Technische Hochschule Aachen, Germany, F.R.. Lehrstuhl fuer Theoretische Physik und Inst. fuer Theoretische Physik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Scaling laws and rates are calculated for the decay of an orthoquarkonium state into a photon and a lighter meson in the framework of perturbative QCD. The different behaviour of q q-bar and gluon component in the meson wave function is emphasized and a possible reason for the strong suppression of iota (1440) in radiative PSI/sup '/ decays is indicated. Predictions for helicity amplitudes in the decay J/PSI->γ + f(->$\pi\pi$) are given and effects on the angular distribution from an interfering γ + ($\pi\pi$)/sub J=0/ contribution are discussed.

4828 (INIS-mf—11041, pp 257-262) **On the influence of hadronic decay on the properties of hadrons.** Dullemond, C.; Rijken, T.A.; Beveren, E. van; Rupp, G. (Katholieke Univ. Nijmegen, Netherlands; Bielefeld Univ., Germany, F.R. Interdisziplinaeres Zentrum fuer Hochschuldidaktik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The definition of bare hadrons (distinguished from physical hadrons) is introduced. A simplified model of a hadron which stimulates the effects of hadronic decay on the properties of hadrons is constructed. (M.F.W.).

4829 (INIS-mf—11041, pp 497-502) **Large p/sub T/ cross section differences as tests of QCD.** Anselmino, N. (Turin Univ., Italy. Ist. di Fisica Teorica). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

It is shown that certain cross-section differences provide a more direct and strict test of the QCD mechanisms and have a much simpler theoretical structure than do the individual cross-sections. They provide a severe test of the Q/sup 2/ evolution of the quark distribution functions and they are very sensitive to quark-gluon scattering and to the existence of the three-gluon coupling. (M.F.W.).

4830 (INIS-mf—11041, pp 503-509) **Two-pion inclusive spectra. A test of models of low-p/sub T/ processes.** Adamus, M.; Dziembowski, Z. (Warsaw Univ., Poland. Inst. Fizyki Doswiadczalnej; Warsaw Univ., Poland. Inst. Fizyki Teoretycznej). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

We compare data on low-p/sub T/ inclusive PI/sup +-/ and PI/sup +-/PI/sup +-/ production in pp collisions at $\sqrt{s}$ = 62 GeV with the predictions of the valon recombination and the two-chain models. Both models agree well with PI/sup -/ and PI/sup -/ PI/sup -/ data but none of them is able to provide a satisfactory description of both PI/sup +/ and PI/sup +/ distributions.

4831 (INIS-mf—11041, pp 529-573) **Particle production in pp-bar interactions at 540 GeV and strange quark suppression.** Boeckmann, K. (Bonn Univ., Germany, F.R. Physikalisches Inst.). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Strange quark suppression at collider energies is studied in data on particle production from the UA5 streamer chamber experiment. The value of the strangeness suppression factor λ = 0.39 +- 0.06 is compared with results from lower energies.

4832 (INIS-mf—11041, pp 547-564) **Chromodynamics of hadronic and nuclear reactions in the perturbative vacuum.** Cohen-Tannoudji, G.; Navelet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Dept. de Physique des Particules Elementaires; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Service de Physique Theorique). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Two topics which can be considered as positive practical tests of QCD are discussed: an estimate of the rise of total hadronic cross sections by means of QCD at the leadings logarithm approximation (LLA) and an estimate of the dependence in the atomic number of structure functions of nuclei (the so called EMC effect) also by means of QCD. (M.F.W.).

4833 (INIS-mf—11041, pp 37-51) **Neutrino mixing with and without scalars.** Tanaka, K. (Ohio State Univ., Columbus, USA. Dept. of Physics). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

We combine grand unified symmetry and extended technicolor symmetry and obtain neutrino mixing without scalars. Then, we discuss gauge boson masses and neutrino mixing with scalars in an O(4) x U(1) gauge model.

4834 (INIS-mf—11041, pp 79-85) **Attempts towards an understanding of mass scales.** Zoupanos, G. (European Organization for Nuclear Research, Geneva, Switzerland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Examples of a class of models in which the colour gauge group is enlarged and subsequently broken to SU(3)/sub C/ are presented. Models of this class naturally accomodate fermions belonging to the usual SU(3)/sub C/ representations as well as new quarks with exotic quantum numbers. Chiral symmetry breaking in the exotic quark sector may occur at much larger mass scales than ordinary chiral symmetry breaking, and could produce dynamical breaking of electroweak gauge symmetry and radiative masses for light fermions. The possibility of quark-lepton unification without proton decay in this class of models is discussed.

4835 (LAL—87-13) **Atmospheric neutrino interaction study in the Frejus detector.** Deuzet, G. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Apr 1987. 149p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750486/JAW.

The detector and its principal characteristics are described. The principles of the methods chosen for the measurement of the direction and energy of the leptons are also described. The different steps in the elaboration of the Orsay Monte-Carlo calculation program are given: characteristics of the atmospheric neutrino flux, calculation of the neutrino cross sections in the range 0.2-20 GeV, and principles of the generation and simulation of neutrino interactions in the detector. The analysis of the experimental data and the comparison with the Monte-Carlo predictions are presented. The experimental data are seen to be in agreement with the calculations for the energy spectra, the confinement efficiency, the number of tranches at the primary vertex and the muon-electron ratio for charged-current events.

4836 (LAPP-TH—144) **Effective Lagrangian in QCD: vector mesons and Skyrmions physics.** Maiella, G. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1985. 8p. (CONF-8507137—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750239/JAW.

From Conference on non-perturbation methods; Montpellier, France (9 Jul 1985).

The purpose of this communication is two fold. We first show that the proper introduction of the triplet of vector mesons, rho, solve in an unique way the confusing question of how to stabilize the baryon solitons (Skyrmions); moreover it fixes the value of the (a-dimensional) constant in the Skyrme term as e $\simeq$ g /sub rho/ $\pi\pi$, explaining the origin of such a term. Second we shall indicate the numerical and analytical support for the main hypothesis made: the rho mesons are the gauge particles associated to SU/sub V/(2), the hidden symmetry of non linear σ model. An outline of the analytical framework is given, and the numerical profile of the soliton solution, F(r), is shown, comparing the results with the Skyrme solution and its static properties.

4837 (LAPP-TH—160) **Heavy quarks and squarks from W-gluon fusion.** Lindfors, J. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). May 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750487/JAW.

We discuss Wg-fusion as a source of heavy quark and squark pairs at very high energy hadron colliders. Effective W approximation is used to calculate the cross-sections analytically in the forward scattering configuration; good agreement is obtained with exact numerical calculations. W-gluon fusion is found to be not nearly as important a production mechanism of heavy squarks as it is of heavy quarks. This is especially true when the mass-splitting within the SU(2)/sub L/ doublet is small.

4838 (LUNFD6/TFME—1012-1-12-1986) **Confinement and lattice gauge theory.** Flensburg, M. (Lund Univ. (Sweden). Dept. of Theoretical Physics). 21 May 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752420/JAW.

In the first paper of this thesis we explore the phenomenological consequences of an improved MIT bag model. Smaller hadronic radii and lager bag constant results from a CMS correction. The new values are found to be consistent with various dimensional parameters in hadron physics. We also calculate the mixed qqg spectrum. Paper II and III deals with a analysis of all existing high statistics lattice Monte Carlo data on the static quark potential for SU(3)/sub 4/, in terms of an effective string theory. Good agreement is found. In paper IV we perform a full SU(2)/sub 2/ lattice Monte Carlo calculation at finite temperature. We determine the deconfinement termperature in the scaling region and compare it with the prediction of the scalar string. The two final papers investigate the possibility to use the complex Langevin equation in generating lattice configuration, including charges, for U(1), for SU(2) and SU(3). The power of the method is illustrated for U(1) in two dimensions, while the method fails in the non-Abelian cases.

4839 (NBI-HE—87-36) **Structure of the high temperature gauge ground state and electroweak production of the baryon asymmetry.** Shaposhnikov, M.E. (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Jun 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750199/JAW.

We investigate the connection of the baryon asymmetry of the universe (BAU) with the Chern-Simons structure of the ground state of gauge theories at high temperatures. We formulate in a explicitly gauge-invariant way the notion of the effective potential for density of the Chern-Simons charge and estimate CP-noninvariant corrections to it coming from the nonequilibrium stages of universe expansion. We find that for the case of trivial structure of the ground state the BAU production is only possible if the low-energy CP-violation in anomalous reactions δ/sub ms/ is larger than 10/sup -4/. We discuss the fate of the CP-domain structure of the univers which appears when there is descrete degeneracy of the ground state. The magnitude of BAU could be large only with sufficiently strong high temperature CP violation. So the BAU generation in the framework of standard electroweak theory (where δ/sub ms/ $\simeq$ 10/sup -18/) takes place only when there is infinite degeneracy. We estimate the Higgs and top masses in the Coleman-Weinberg type of the theory.

4840 (RAL—86-100) **Two-photon physics.** Cartwright, S.L. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 22p. (CONF-860943—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750210/JAW.

From 6. international conference on physics in collision; Chicago, IL, USA (3 Sep 1986).

A brief review of hadron production in two-photon interactions is presented. The emphasis is upon recent experimental results, particularly in the fields of meson formation and event topology in inclusive hadron production.

4841 (RAL—87-005) **Note on the narrow 3.1 GeV (Λ p-bar + pions).** Chan Hongmo; Tsou Sheungtsun. (Rutherford Appleton Lab., Chilton (UK)). Feb 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750227/JAW.

It is pointed out that the narrow exotic U(3.105) (Λ p-bar + pions) state reported at CERN and Serpukhov and its companion at 3.410 GeV, fall neatly on top of the spectrum predicted nine years ago for 'M-baryoniums' and agree with the expected decay characteristics. Further, when so interpreted, their spacing gives a direct measure of the colour Casimir factor in the string tension.

4842 (RAL—87-031) **Strong and electroweak properties of quarks.** Marshall, R. (Rutherford Appleton Lab., Chilton (UK)). Apr 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750225/JAW.

The paper concerns the experimental determination of the strong and electroweak properties of quarks from e^+e^- interactions at PEP and PETRA. The properties investigated include: total cross section R, forward-backward charge asymmetries, - electroweak parameters, radiative final states, polarisation, and quark structure. (U.K.).

4843 (RAL—87-039) What do we lean from the EMC [European Muon Collaboration] effect. Close, F.E. (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 12p. (CONF-870413—14). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750221/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The present theoretical understanding of the EMC effect is reviewed and questions for experiment are posed. The empirical status of rescaling is discussed and the author shows how it can make statements about the static properties of bound nucleons; in particular that sup(g)A/sup(g)V and μ of bound nucleons are unchanged from their free values once pion exchange contributions are taken into account. This suggests that the increased correlation length for quarks is due to exchange effects, not due to physical swelling of nucleons.

4844 (RAL—87-040) Anti-selection rule for C = + glueball decays. Close, F.E. (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750226/JAW.

If a glueball can decay into pairs of pseudoscalar mesons, then rather general arguments on flavour symmetry breaking imply that BR(G → etaeta) > 1/2 BR(G → K^+K^-), BR(G → etaeta ') < 1/2 BR(G → eta 'eta '). The significance of KK* decays is also discussed.

4845 (UWThPh—1987-01) K/sup 0/ -> π/sup 0/$\gamma\gamma$ decays in chiral perturbation theory. Ecker, G.; Pich, A.; Rafael, E. de. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 15p. (CPT—87/P.E.1982). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700070/JAW.

The decays K/sub L,S/ -> π/sup 0/$\gamma\gamma$ are calculated within the framework of chiral perturbation theory. The amplitude for K/sub L/ -> π/sup 0/$\gamma\gamma$ is found to be finite at the one-loop level yielding a branching ratio of 6.8 center dot 10/sup -7/. The decay spectra of both decays are very characteristic and provide good tests of the effective chiral symmetry realization of the Standard Model.

4846 (UWThPh—1987-19) CP violating mixing matrix compatible with neutral flavour conservation and spontaneous CP violation. Ecker, G.; Grimus, W.; Neufeld, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700074/JAW.

A specific ansatz for the Yukawa couplings of a four-generation SU(2)/sub L/ x U(I) model with two Higgs doublets is discussed which leads to neutral flavour conservation, spontaneous CP violation and to a genuinely complex mixing matrix. W exchange conserves CP in the limit m/sub t'/ = m/sub t/ only. The decay rate for t -> b is reduced by a factor two compared to the Standard Model with three generations. The phenomenological implications for K/sup 0/-K-bar/sup 0/ and B/sup 0/-B-bar/sup 0/ are investigated.

4847 Analytic forms for the e^+e^- annihilation cross section near the Z including initial-state radiation. Cahn, R.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2666-2670(1 Nov 1987). Contract AC03-76SF00098.

Beginning with the initial-state radiation formula of Kuraev and Fadin, simple analytic forms are obtained for e^-e^+ annihilation near the Z. The technique is applied to the total cross section and the left-right asymmetry.

4848 Eta-eta' mixing angle. Gilman, F.J.; Kauffman, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2761-2767(1 Nov 1987). Contract AC03-76SF00515.

The current experimental evidence on the value of the eta-eta' mixing angle is summarized in the light of our present theoretical understanding. A value of θ/sub P/≃-20° is consistent with all present evidence.

4849 Heavy-Higgs-boson production and W^-W^+ scattering processes in e^-e^+ collisions at high energy. Gunion, J.F.; Tofighi-Niaki, A. (Department of Physics, University of CaliforniaDavis, California 95616). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2671-2681(1 Nov 1987).

We employ exact matrix elements for the reactions $e^-e^+ \to \nu\text{nu-bar}W^-W^+$ and $e^-e^+ \to e^-e^+W^-W^+$ to explore the observability of a standard-model Higgs boson and of W^-W^+ scattering processes at a high-energy e^-e^+ collider. We consider representative e^-e^+ center-of-mass energies of $\sqrt{s}$ = 0.5, 1, and 2 TeV.

4850 Restrictions on tau⁻→eta$\pi^-\nu$ in two-Higgs-doublet models. Meurice, Y. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2780-2787(1 Nov 1987). Contract W-31-109-ENG-38.

We consider several phenomenological constraints for a large class of two-Higgs-doublet models. We show that a significant (>0.1%) branching ratio for the second-class decay tau⁻→eta$\pi^-\nu$ can be excluded for the models satisfying the "naturalness" requirements of Glashow and Weinberg. If one of these requirements is relaxed, a substantial (>1%) branching ratio for this mode cannot be ruled out, but this requires a rather large coupling to the tau lepton. Implications for pp-bar and pp experiments are briefly discussed.

4851 Oscillation searches via neutrino-electron scattering. Marciano, W.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2859-2862(1 Nov 1987). Contract AC02-76CH00016.

The effect of neutrino flavor oscillations on neutrino-electron scattering is examined. A proposed LAMPF experiment designed to determine $\sin^2\theta$/sub W/ to +- 0.002 via a measurement of R'equivalentσ(ν/sub μ/e)/[σ(ν/sub e/e)+σ(nu-bar/sub μ/e] is shown to probe ν/sub μ/-ν/sub e/ oscillations with $\sin^2 2\theta_1$approx. >0.003 and Δm^2 /sub 21/ as small as 0.06 eV^2.

4852 K^+-nucleon central interaction in a quark potential model. Campbell, R.K.; Robson, D. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2682-2692(1 Nov 1987).

The K^+-N interaction is calculated with a quark potential model using the resonating-group method (RGM). For the central interaction, 2h-dash-barω mixed-symmetry harmonic-oscillator components of the nucleon wave function and 2h-dash-barω components of the kaon wave function are included in the calculation of the RGM kernels. These components make a significant contribution to the interaction kernels. The total isospin I = 0 S-wave phase shifts are in good agreement with the experimentally determined phase shifts. The I = 1 interaction does not exhibit enough repulsion.

4853 Multiplicity distributions from branching equations with constant vertex probabilities. Durand, B.; Sarcevic, I. (Department of Physics, University of Wisconsin, 1150 University Avenue, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2693-2701(1 Nov 1987).

We present multiplicity distributions which are solutions to branching equations, based on the assumption that the shapes and energy dependence of multiplicity distributions are principally determined by hard parton scattering and subsequent branching. We consider the four processes g→gg, q→qg, g→qq-bar, and in a few cases g→ggg. All vertex probabilities for these processes are taken to be constant. In this simple approximation, we find that Koba-Nielsen-Olesen scaling is systemically violated. We compare the properties of branching distributions with the properties of the widely used negative-binomial distribution and of the stochastic approach.

4854 Polarized-proton-proton scattering at 90 degrees in the c.m. system. Tomozawa, Y. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48109). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2854-2856(1 Nov 1987).

We show that (1) the spin-triplet amplitude of antiparallel proton scattering vanishes at the center-of-mass angle $\theta = \pi/2$, and (2)= the ratio dσ(up-arrowup-arrow)/dσ(up-arrowarrow-down) reaches 4 at $\theta = \pi/2$, provided that the average of the spin-triplet amplitudes and the spin-singlet amplitude become equal.

4855 Quark compound bag model for NN scattering up to 1 GeV. Fasano, C.; Lee, T.H. (University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1906-1915(Nov 1987).

A quark compound bag model has been constructed to describe NN s-wave scattering up to 1 GeV. The model contains a vertex interaction H/sub D//sub bold-arrow-left-right//sub NN/ for describing the excitation of a confined six-quark bag state, and a meson-exchange interaction obtained from modifying the phenomenological core of the Paris potential. Explicit formalisms and numerical results are presented to reveal the role of the bag excitation mechanism in determining the relative wave function and the P and S matrices of NN scattering. We explore the merit as well as the shortcomings of the quark compound bag model developed by the Institute of Theoretical and Experimental Physics group. It is shown that the parameters of the vertex interaction H/sub D//sub bold-arrow-left-right//sub NN/ can be more rigorously determined from the data if the concept of the chiral/cloudy bag model is used to justify the presence of the background meson-exchange interaction inside bag excitation region. The application of the model to the study of quark degrees of freedom in nuclei is discussed.

4856 Protonium and baryonium states with the Graz potential. Landau, R.H.; Schnick, J. (Physics Department, Oregon State University, Corvallis, Oregon 97331). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1942-1949(Nov 1987).

Atomic and nuclear complex energy (Gamow) states of the p-barp system are calculated with the Graz potential. The Coulomb force is included exactly (numerically), separate channels and experimental masses are used for p-barp and n-barn, and absorption is included via a phenomenological annihilation channel. Significant model dependence of the n = 1 $^1S_0$ protonium level is found, as is a possible systematic difference among most calculations and recent experiments. Bound and resonant states of baryonium are found in a number of charge and isospin channels, some with widths as narrow as 16 MeV. Unphysical zero width states are also found and analyzed.

4857 Theoretical limit on iota→rhoγ and constraints on glueball—qq-bar-meson couplings with the pion and the isovector photon. Slaughter, M.D.; Oneda, S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 15, 1641-1644(12 Oct 1987).

Within the formalism and theoretical framework of asymptotic SU/sub F/(4) symmetry plus the constraint algebras involving the generators of the underlying symmetries of QCD, we derive an important relation between meson isoscalar-isovector matrix elements of the electromagnetic current and corresponding matrix elements of the axial-vector charge A/sub π/. A lower bound is calculated for the rate Γ(iota→rhoγ) which indicates that Γ(iota→rhoγ) is of the order of 1 MeV, with its exact value depending upon the rates Γ(iota→$\delta\pi$) and Γ(δ→etaπ). The estimate of the lower bound is independent of the specific quark and glue content of the iota.

4858 Cancellations in two-step OZI-violating transitions. Lipkin, H.J. (Argonne National Lab., IL, USA; Weizmann Inst. of Science, Rehovoth, Israel. Dept. of Nuclear Physics). *Nuclear Physics [Section] B;* **291**: No. 4, 720-730(14 Sep 1987). Contract W-31-109-ENG-38.

Arguments based on flavor symmetry and charge conjugation show how cancellations occur between contributions from different hadronic intermediate states to two-step OZI-violating transition amplitudes in which each individual step is OZI allowed. Such cancellations cannot occur at masses above one and only one OZI-allowed threshold. Larger OZI violations should occur in these mass regions.

4859 From a new smell to a new flavour - B/sub d/-anti B/sub d/ mixing, CP violation and new physics. Bigi, I.I.; Sanda, A.I. (Stanford Linear Accelerator Center, CA, USA; Rockefeller Univ., New York, USA). *Physics Letters [Section] B;* **194**: No. 2, 307-311(6 Aug 1987). Contract AC03-76SF00515;AC02-87ER40325.

Using the preliminary data on B/sub d/-anti B/sub d/ mixing from ARGUS, and the standard model with three families, we infer a lower bound on the top quark mass of 50-70 GeV; also, B/sub s/-anti B/sub s/ mixing has to be close to maximal. We discuss how the prospects for observing CP violation in B/sup 0/ decays are enhanced and sketch alternative scenarios for new physics.

4860 Radiative Bhabha scattering for singly tagged and untagged configurations. Karlen, D. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Physics [Section] B;* **289**: No. 1, 23-35(20 Jul 1987). Contract AC03-76SF00515.

A method for simulating radiative Bhabha scattering for configurations where one or both electrons do not scatter appreciably is presented. Double radiative Bhabha scattering is included by using the equivalent photon approximation. Results from a Monte Carlo event generator are shown for two experimental configurations. When an electron and photon scatter at large angles, the contribution from order α/sup 4/ is large for low visible energies. For the single photon configuration, the order α/sup 4/ correction is small.

4861 "The reactions $K^-d \rightarrow N\Lambda\pi$ and $N\Sigma\pi$". Torres, M.; Dalitz, R.H.; Deloff, A. (Department of Theoretical Physics, Oxford University, Oxford). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 901-905(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The reactions $K^-d \rightarrow N\Lambda\pi$ and $N\Sigma\pi$ are calculated using a three-body multichannel formalism and two-body interactions between all pairs of particles. Quantitative agreement with the data on relative rates and spectra is found using acceptable two-body potentials. The results imply that there is no unstable bound state (2nd sheet pole above Λ N threshold) in the (ΣN, ΛN) system but do require a virtual state (4th sheet pole) near the ΣN threshold.

4862 Effects on spin asymmetries of special effects at 90°. Lipkin, H.J. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1153-1160(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Spin effects in hadron-hadron elastic scattering which reach a maximum near 90 degrees and drop off at small angles are described in terms of quark and gluon exchange mechanisms.

4863 Leptonic decays of heavy leptonium. Malenfant, J. (Department of Physics, University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 595-596(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A method for calculation of radiative corrections to the leptonic decay of muonium and tauonium is outlined. Numerical values for particle lifetimes are given.

4864 KMC unitarity and $K^+ \rightarrow \pi^+ \nu\text{nu-bar}$. Marciano, W.J. (Department of Physics, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 956-960(15 Oct 1986). (CONF-860575—). Contract AC02-76CH00016.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Experimental constraints on the Kobayashi-Maskawa-Cabibbo (KMC) matrix are surveyed and shown to provide a test of the standard model at the level of its O(α) radiative corrections. The three generation prediction B R($K^+ \rightarrow \pi^+$ nu-barnu-bar≃(0.35∼3) x 10/sup -10/ is reviewed and the potential for enhancement up to ≃3 x 10^{-9} due to the fourth generation mixing is described.

4865 **Summary of hypernuclear sessions.** Chrien, R.E. (Brookhaven National Laboratory, Upton, New York 11973-5000). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 325-333(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

This talk is a summary of the reports which discuss the relationship of hypernuclei with the topic of this conference Intersections Between Particle and Nuclear Physics .

4866 **Models of multiquark states.** Lipkin, H.J. (Argonne National Laboratory, Argonne, IL 60439 and Department of Physics, Weizmann Institute of Science, Rehovot, Israel). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 657-671(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The success of simple constituent quark models in single-hadron physics and their failure in multiquark physics is discussed, emphasizing the relation between meson and baryon spectra, hidden color and the color matrix, breakup decay modes, coupled channels, and hadron-hadron interactions via flipping and tunneling of flux tubes. Model-independent predictions for possible multiquark bound states are considered and the most promising candidates suggested. A quark approach to baryon-baryon interactions is discussed.

4867 **Multi-quark states in a QCD-like potential model.** Maltman, K. (T5-B283 Los Alamos National Laboratory, Los Alamos, N.M., 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 672-675(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The requirements of quark antisymmetry and the color-spin structure of the quark hyperfine interaction generate effective short range NN repulsion, in agreement with observation. Multi-quark channels where these same aspects of the underlying quark physics favor formation of exotic states are identified. Narrow resonances are not expected. The non-existence of these states would most likely require unexpected confinement physics in the multi-quark sector and a re-evaluation of the apparent successes of the quark picture of the origin of the short range structure of the NN force.

4868 **Flux tubes in multi-quark systems.** Robson, D. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 676-685(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The many-body properties of flux tubes are outlined and found to lead to a modified Pauli Principle for quarks in different hadrons. Incorporation of flux tube ideas into nucleon-nucleon potential models including one pion exchange yields a repulsive core without invoking one gluon exchange and provides a reasonable description of the low energy properties of the nucleon-nucleon system with only four parameters. The size of nucleons in A = 2 and 3 nuclei are found to increase by a few percent at small nucleonic separations.

4869 **K^+-N, K^+/sup */-N channel coupling in a quark potential model.** Campbell, R.K. (Florida State University, Tallahassee, FL 32306). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 686-687(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The K^+-N interaction was calculated with a quark potential model using the resonating group method (RGM). For the central interaction the 2h-dash-baro components of the nucleon and kaon wave functions were included in the RGM kernels. The total isospin I = 0 s-wave phase shifts are in good agreement with experimental results. The I = 1 interaction does not exhibit enough repulsion. The K^+-N channel was coupled to the K^+-N channel via quark exchange. The channel coupling gives effectively a more repulsive interaction for both I = 1 and I = 0.

4870 **Anomalous dimensions of multiquark bound states.** Chueng-Ryong Ji. (Stanford Linear Accelerator Center, Stanford University, Stanford, California, 94305 and Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 688-691(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00515.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The evolution of six-quark color-singlet state distribution amplitudes is formulated as an application of perturbative quantum chromodynamics to nuclear wave functions. We present a general method of solving the evolution equation for multiquark bound states and predict the asymptotic Q^2 slope for the deuteron charge form factor as a result.

4871 **Spectroscopy without quarks: A Skyrme-model sampler.** Karliner, M.; Mattis, M.P. (SLAC, bin 81, Stanford, CA 94305). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 762-769(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A potpourri of Skyrme-model results for the meson-baryon system is surveyed.

4872 **Light quark pairs in heavy quarkonia.** Byers, N.; Zambetakis, V. (Department of Physics, University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 770-772(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We report results of a study of potential models qhich explicitly include light quark pair production vacuum polarization effects. Fits to the cc-bar and bb-bar data including leptonic and hadronic widths of psi″(3772) give 0.31 GeV^2 for the slope of the linear potential (string tension), a value significantly higher than the value of 0.22 GeV^2 obtained without explicit account taken of light quark pair production. This fit to the data is obtained in a model in which the confining potential is Lorentz vector. We are not able to find parameter values to fit the data in models in which the confining potential is scalar.

4873 **Phase transitions in QCD from the lattice perspective.** Gavai, R.V. (Physics Department, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 848-857(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief survey of the latest results in the field of finite temperature lattice quantum chromodynamics (QCD) is presented with special emphasis on simulations that incorporate the dynamical fermions. For the theory with four light flavors, three different apparently unequivalent methods yield results in quantitative agreement with each other. Recent attempts to obtain nonperturbative esti-

mates of the velocity of sound in both the hadronic and quark-gluon phase are summarized along with the results.

4874 **Future of high-energy physics.** Bjorken, J.D. (Fermi National Accelerator Laboratory, Batavia, Il 60510). *AIP (American Institute of Physics) Conference Proceedings;* **134**: No. 1, 320-330(20 Nov 1985). (CONF-8307126—).

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

The present status of the theoretical aspects of High Energy Physics is the standard model of Quantum Chromodynamics and the electroweak SU(2)xU(1) model. The future is dependent upon the outcome of a number of shortfalls the theory has when compared with physical reality. (These shortfalls are listed in the article). A high energy machine such as the SSC project is needed to determine the outcome of these shortfalls. (AIP)

4875 **The approach of pp and pp-bar elastic scattering to "asymptopia".** Block, M.M.; Cahn, R.N. (Northwestern Univ., Evanston, IL 60201). pp 296 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors study a gray disk model that reproduces these values of σ/sub tot/ and B. As an example, the impact parameter representations for these two models at $\sqrt{s} = 40$ TeV are shown. The corresponding elastic differential cross sections are shown. They note that when the diffraction minima are filled in by the contribution of the real amplitude (rho not equal to 0), the difference between the disk and the Chou-Yang model is small and would be hard to detect experimentally. In essence, at the SSC energy the Chou-Yang model has already gone over to a grey disk, with a negative curvature parameter, C = 1/2 (d/sup 2/(iota n d σ/dt)/dt/sup 2//sub t=0/. In contrast, at the SPS Collider energy, where $C > 0$, the differential cross sections are substantially different in the two models. If they define $C = 0$ as the onset of asymptopia for elastic scattering, they find this will occur near the Tevatron Collider energy, $\sqrt{s} = 2$ TeV.

4876 **Multiplicity distributions as a test of dynamics.** Durand, B. (Dept. of Physics, Univ. of Wisconsin, Madison, WI 53706). pp 292 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors compare a multiplicity distribution derived from a QCD-like branching process distribution derived from a quantum optics counting process.

4877 **Heavy dimesons.** Heller, L.; Tjon, J.A. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 290-291 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The Born-Oppenheimer approximation for heavy quarks in the MIT bag is extended to the Q/sup 2/Q-bar/sup 2/ system, where the glue plus volume energy becomes an operator in color space. Taking its lowest eigenvalve as the approximate potential energy, the four-body Schrodinger equation is solved variationally for the ground-state energy. With this approximation, it is found that heavy quark systems such as c/sup 2/c-bar/sup 2/ are stable against breakup into two PSI(cc-bar) mesons. It is necessary to solve the coupled channel (in color space) problem to confirm this result.

4878 **Quark and gluon fragmentation into two mesons from jet calculus.** Lassila, K.E.; Ng, A. (Ames Lab., Iowa State Univ.). pp 352 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors present their calculations of fragmentation functions for quark and gluon breakup into two mesons within the jet calculus framework. The momentum fraction and Q/sup 2/ dependence of such two particle functions are presented and studied. The dependence on these variables is compared with the calculation by Willen who appends phenomenological fragmentation functions to the two parton jet calculus diagrams. Their approach requires all four parton diagrams. The Q/sup 2/ dependence of meson-meson correlations found by Willen are quite different from that in our approach and the two should be experimentally differentiated.

4879 **Quark-antiquark hadroproduction of psi-mesons via two gluons.** Harms, B.; Cox, P.H. (Univ. of Alabama). pp 353 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have calculated the contribution of the process qq-bar $\rightarrow$ PSI G via two intermediate gluons to the total cross section for PSI-meson production in πp and p-barp collisions. They find that near threshold, the energy region in which the differential cross section is the largest, this process gives a cross section at least an order of magnitude larger than that of the process qq-bar $\rightarrow$ PSI GG. This is somewhat surprising because the latter process has only one intermediate gluon and thus is of lower order in α/sub s/ than the process they studied here. They find that for α/sub s/ = 0.22 the process studied here can account for a large fraction of the cross section for PSI - production in π p and pp collisions and of the difference $\sigma(pp \rightarrow PSIx) - \sigma(p\bar{p} \rightarrow PSIx)$.

4880 **Some comments on α/sub S/ and Λ/sub MS-bar/.** Knuteson, R.O.; Durand, B. (Univ. of Wisconsin). pp 352 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have determined values of α/sub s/ from leptonic and hadronic decay widths of the bb-bar and cc quarkonium states. Their use of the Fermi-Segre formula relating vertical bar PSI/sub n/(0)vertical bar, and thus the widths Γ/sub n/, to the measured spectrum dE/sub n//dn, gives them more sensitivity to α/sub s/ (using standard QCD formulas) than other determinations using ratios of decay widths. Another technique for extracting values of α/sub s/ is jet analysis. They have collected some 40 data points using all three techniques (all highly model dependent), to compare α/sub s/(Q/sup 2/) over two decades in Q with the theoretical behavior given by the renormalization group. The theoretical α/sub s/(Q/sup 2/) is parameterized by Λ/sub MS-bar/, whose asymptotic six-flavor value is or great interest. Unfortunately, even the "best" set of data points from all three techniques allows a band of Λ/sub MS-bar/ values from around 5 to 500 MeV.

4881 **QCD corrections to the decay b $\rightarrow$ Psi x.** Cox, P.H.; Hovater, S.; Jones, S.T.; Clavelli, L. (Univ. of Alabama). pp 350 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have calculated the lowest order QCD corrections to the decay of b quarks into psi mesons, including virtual and real qluon contributions. They use the charmonium based model for

the psi. Results indicate that the decay rate is decreased by these corrections. Since the rate calculated from the leading (Born) term exceeds the experimental rate for B→psi x. these corrections decrease the discrepancy.

4882 **Grand unified theories.** Marciano, W.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 98-113(May 1984). (CONF-8309163—). Contract AC02-76CH00016.

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

An overview of current topics and problems in the attempt to construct a Grand Unified Theory is presented. (AIP)

4883 **No-neutrino double beta decay: More than one neutrino?.** Rosen, S.P. (T-Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 176-183(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

Interface effects between light and heavy Majorana neutrinos in the amplitude for no-neutrino double beta decay are discussed. The effects include an upper bound on the heavy neutrino mass, and an A dependence for the effective mass extracted from double beta decay. Thus the search for the no-neutrino decay mode should be pursued in several nuclei, and particularly in Ca^{48}, where the effective mass may be quite large.

4884 **Status of μ decays.** Kinnison, W.W. (Los Alamos National Laboratory, MS D443, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 226-241(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

A short theoretical review of the weak interaction is presented with particular emphasis on the implications to normal and rare muon decay processes. This review addresses the standard theory, left-right symmetric theories, theories with horizontal symmetries, and composite models. A survey of experiments currently in progress to study both rare and normal muon decays is then presented with particular emphasis on the Los Alamos high statistics muon decay experiment and its implications for left-right symmetric theories.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 4751, 4793, 4794, 4798, 4801, 4846, 4942, 4945, 5114

4885 **(BONN-HE—87-08) On exceptional operator algebras in the conformally invariant SU(2) Wess-Zumino-Witten model.** Christe, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750185/JAW.

The exceptional closed operator algebras appearing in the d=2 conformally invariant SU(2) σ-model with Wess-Zumino term as the Kac-Moody central charge k/sub A1/ takes the values 10 and 28 are investigated. They are identified with the Spin(5) and G/sub 2/ σ-models with Wess-Zumino term and a Kac-Moody central charge equal to one in both cases. These are together with the case k/sub A1/=1, where an SU(3) model appears, the unique possibilities that a closed subalgebra of operators is in fact governed by the properties of another simple group.

4886 **(DOE/ER/02171—225) Compound-nuclear tests of time reversal invariance in the nucleon-nucleon interaction.** French, J.B.; Pandey, A.; Smith, J. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER02171. 21p. (CONF-8704152—3; UR—1018). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014044/JAW.

From Workshop on tests of time reversal invariance in neutron physics; Chapel Hill, NC, USA (17 Apr 1987).

The theory for the effects of time-reversal noninvariance (TRNI) in complex systems is reviewed. Applied to the compound-nuclear data for energy-level, width and cross-section fluctuations (the latter for detailed-balance pairs of reactions proceeding through the compound nucleus) this gives bounds on multiparticle TRNI Hamiltonian matrix elements. Using a fluctuation-free form of statistical spectroscopy the results are reduced to bounds on α, the relative magnitude of the TRNI nucleon-nucleon interaction. The level and width analyses for heavy nuclei gave $\alpha \leqq 2 \times 10^{-3}$ at high (~99%) statistical confidence; preliminary calculations for detailed balance with $^{24}Mg(\alpha,p)^{27}Al$ and its inverse gives $\alpha \leqq 4 \times 10^{-3}$ at the same high confidence, but $\leqq 0.2 \times 10^{-3}$ at 80% confidence. Suggestions are made about experiments which should yield sharper bounds. 28 refs., 1 tab.

4887 **(EFI—883-34-86) Hierarchy of breaking scales in SO(10) grand unified theory and particle masses.** Asatryan, G.M.; Ioannissyan, A.N. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700316/JAW.

A model is suggested of SO(10) grand unification with additional discrete symmetry, where the quark mass spectra problem usually arising in SO(10) breakdown schemes with intermediate SU(2)/sub L/ x SU(2)/sub R/ symmetry is solved. From the condition of existence of only one light Higgs boson arelation has been obtained between b and t quarks masses which enables one to fix a ratio of grand unification scale M/sub x/ to quark-lepton symmetry breaking scale M/sub c/. A concrete value of M/sub x/ depends on the Meinberg angle and is in agreement with the proton decay experiments. 8 refs.; 1 fig.

4888 (INIS-mf—11041, pp 17-36) **Search for new interactions: supersymmetry and violation of CP.** Bigi, I.I. (Technische Hochschule Aachen, Germany, F.R. Lehrstuhl fuer Theoretische Physik und Inst. fuer Theoretische Physik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A short review of the theoretical and experimental understanding of CP violation is presented. Motivations are given to search for new interactions and, as a prime example, (global) supersymmetry is discussed as a source of CP violation at low energies. It is speculated that supersymmetry in composite models could lead to a unique source of CP violation.

4889 **(NBI-HE—87-25) Unitary representations of the N=4 SU(2) extended superconformal algebras.** Yu, M. (Niels Bohr Inst., Copenhagen (Denmark)). Apr 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750203/JAW.

Unitarity conditions for the N=4 SU(2) extended superconformal algebras (SUCA's are derived. All highest weight unitary representations are identified and explicitly realized by free fermion and (twisted) boson constructions, which are essentally free theories. Some aspects of this construction are discussed.

4890 **(NBI-HE—87-38) Unitary constructions of the N=4 SU(2) extended supconformal algebras.** Yu, M. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750451/JAW.

Unitarity conditions for the N=4 SU(2) extended superconformal algebras (SUCA's) are derived. All highest weight unitary representations are identified and explicitly realized by free fermion and (twisted) boson constructions, which are essentially free theories.

4891 **(UWThPh—1987-21) Generalized CP invariance, neutral flavour conservation and the structure of the mixing matrix.** Neufeld, H.; Grimus, W.; Ecker, G. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700076/JAW.

CP invariance of SU(2)/sub L/ x U(1) gauge theories is formulated in the most general way. Certain useful standard forms for CP transformations are presented. After a review of horizontal symmetries inducing neutral flavour conservation, we discuss a toy model where CP invariance enforces neutral flavour conservation in a non-trivial way. It is shown that spontaneous CP violation in its general form and neutral flavour conservation lead to a real mixing matrix for three generations. For more than three generations, the mixing matrix may violate CP. A complete analysis of the possible mixing matrices for any number of generations is performed for the usual case of real Yukawa couplings. If the mixing matrix violates CP, some of its elements must be equal in absolute magnitude. For four generations, all possible structures compatible with experiment are specified.

4892 **(UWThPh—1987-23) Standard form for generalized CP transformations.** Ecker, G.; Grimus, W.; Neufeld, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700078/JAW.

The investigation of general CP transformations leads to transformations of the form U -> W/sup T/UW with unitary matrices U, W. It is shown that a basis for weak eigenstates can always be chosen such that W/sup T/UW has a certain real standard form.

4893 **Are nucleons and deltas deformed?.** Bourdeau, M.; Davidson, R.; Mukhopadhyay, N.C... (Department of Physics, Rensselaer Polytechnic Institute, Troy, New York 12181). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 749-750(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We investigate the extraction and modelling of the electromagnetic multipoles in the transition Nbold-arrow-left-rightΔ(1232). We show that the extracted E2 multipole amplitude indicates that nucleons and deltas are not spherical. We study these deformations in various models and discuss possible experiments to test these theoretical inferences.

4894 **Test of time reversal symmetry with resonance neutron scattering.** Bowman, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1194-1197(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Discussions for using thermal neutron scattering from nuclei for symmetry measurements stem from past experiments which have observed large parity violating effects in neutron scattering. The proposed LAMPF II proton storage ring spallation neutron source is a vast improvement over the neutron source used in the parity measurements. A proposal for a time reversal symmetry measurement at the LAMPF II facility is presented. (AIP)

4895 **Octets, triplets and the top quark mass.** Ovrut, B.A. (Dept. of Physics, Univ. of Pennsylvania, Philadelphia, PA 19104). pp 402-404 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors discusses N=1 locally supersymmetric Grand Unified Theories in which both the gauge group and supersymmetry and spontaneously broken in the same sector. It is proven that all such theories naturally contain light SU(3)/sub C/ octet, SU(2)/sub L/ triplet, and U(1)/sub Y/ singlet chiral superfields in the low energy Lagrangian. He shows that these superfields lower the prediction of the top quark mass by at least 20 GeV, facilitating agreement with the experimental data.

4896 **Neutron-antineutron oscillations or High energy physics below 25 meV.** Goodman, M.S.; Wilson, R.; Cohn, H.O.; Gabriel, T.A.; Miller, P.D.; Obenshain, F.E.; Lillie, R.A.; Spencer, R.R.; Young, G.R.; Brau, J.E.; and others. (Department of Physics, Harvard University, Cambridge, MA 02138). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 17-35(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

Technicalities involved in a precision experiment to search for and measure neutron-antineutron oscillations are named and discussed. Physical significance of neutron-antineutron oscillations are also presented. (AIP)

4897 **Neutron oscillation experiments using ultracold neutrons.** Petschek, A.G. (Los Alamos National Laboratory, Los Alamos, N.M. 87545). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 47-53(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

The figure of merit for a neutron oscillation experiment using ultracold neutrons is shown to be competitive with that for beam experiments.

6454 Field Theory

REFER ALSO TO CITATION(S) 4581, 4587, 4770, 4801, 4829, 4834, 4836, 4855, 4873, 4876, 5202, 5203, 5204, 5205, 5332

4898 **(ANL-HEP-TR—87-07) Argonne National Laboratory, High Energy Physics Division: Semiannual report of research activities, July 1, 1986-December 31, 1986.** (Argonne National Lab., IL (USA). High Energy Physics Div.). 1987. Contract W-31109-ENG-38. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000787/JAW.

This paper discusses the research activity of the High Energy Physics Division at the Argonne National Laboratory for the period, July 1986-December 1986. Some of the topics included in this report are: high resolution spectrometers, computational physics, spin physics, string theories, lattice gauge theory, proton decay, symmetry breaking, heavy flavor production, massive lepton pair production, collider physics, field theories, proton sources, and facility development. (LSP)

4899 **(CONF-8708143—3) Linearly confining force from quark and gluon condensates.** Namyslowski, J.M. (Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej). 1987. 9p. (CONF-8709160—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900022/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

Quark and gluon condensates of QCD sum rules <absolute value of ($\sqrt{}$ α/sub s/ psi-bar psi)> = -(240 MeV)^3, and <absolute value of (α/sub s//π G/sub μ nu/ G/sup μ nu/)> = (360 +- 20 MeV)^4 generate quark and gluon self-energies, as well as an extra term, which in light front dynamics gives linearly confining force. Transversality of the gluon self-energy, following from Ward identity, selects this extra term. The term is proportional to product of null vectors, and in hadron bound-state equations it gives a linear quark-antiquark potential V/sub qq-bar/(r) = λr, λ = (0.13 +- 0.03) GeV^2, in any light meson. In baryons the linear quark-quark potential is (8/9)^2/2 $\approx$ 0.4 weaker. The above λ corresponds to string tension equal to (0.17 +- 0.03) GeV^2, and to the slope α' of Regge trajectories within experimental errors α' = (1.0 +- 0.2) GeV^{-2}. 9 refs., 4 figs.

4900 **(DOE/ER/40272—30) Introduction to string field theory.** Ramond, P.; Ruiz-Altaba, M. (Florida Univ., Gainesville (USA). Dept. of Physics). May 1987. Contract FG05-86ER40272. 54p. (CONF-8612111—1; UFTP—87-2). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014583/JAW.

From 2. Mexican school on particles and fields; Cuernavaca, Mexico (1 Dec 1986).

A pedagogical introduction to the field theory of open strings, non-commutative geometry, and some geometrical notions on loop space. 62 refs.

4901 **(IAE—4317/1) Plane longitudinal waves in solutions of Maxwell equations.** Kotel'nikov, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700347/JAW.

It is shown that Maxwell equations admit solutions in the form of longitudinally polarized plane electromagnetic waves. Transformation properties of the fields in the frames of Galilei and relativistic symmetries are determined. Invariants of the fields transformation are plotted. 10 refs.

4902 **(IAE—4321/1) Virial theorem: myth and reality. On contradictions of classical electrodynamics.** Morozov, V.M.; Lebedeva, N.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700349/JAW.

A contradictory nature of energy structures of classical electrodynamics based on the idea of the existence of 4-momentum density of the electromagnetic field expressed through the field strength is discussed. It is stated that the cause of contradiction is the systematic use in the theory the representation of energy in Newton and concept of energy in Lorentz-Poincare-Eisnstein mechanics as coinciding and incompetible. It is shown that the expression of 4-momentum density of the electromagnetic field through the field strength cannot exist and be compatible with the principles of Lorentz-Poincare-Einstein mechanics. The conclusion concerning principal incompleteness of electrodynamic systems is made. 1 ref.

4903 **(IAE—4336/1) Instanton in supersymmetric theory with static disorder.** Babichenko, V.S.; Kozlov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700357/JAW.

Quantum corrections for a "tail" of state density in the disordered chain are calculated. The semiclassical solution in the supersymmetry theory is obtained and integration by the zero modes of boson and fermion fields is made. 8 refs.; 2 figs.

4904 **(IFT-P—21/87) Perturbative coherence in field theory.** Aldrovandi, R.; Kraenkel, R.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700366/JAW.

A general condition for coherent quantization by perturbative methods is given, because the basic field equations of a fild theory are not always derivable from a Lagrangian. It's seen that non-lagrangian models way have well defined vertices, provided they satisfy what they call the 'coherence condition', which is less stringent than the condition for the existence of a Lagrangian. They note that Lagrangian theories are perturbatively coherent, in the sense that they have well defined vertices, and that they satisfy automatically that condition. (G.D.F.).

4905 **(IFUSP-P—616) On a phase transition of a Kosterlitz-Thouless-type in the d=4, U(1)-lattice gauge theory.** Marchetti, D.H.U.; Perez, J.F. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700367/JAW.

The d=4, U(1)-lattice gauge theory with the Villain action may be represented as a locally neutral gas of topological (plaquette) charges which interact via a logarithmically confining potential, is shown. Using this representation a renormalization group analysis to show the existence of a phase transition of the Kosterlitz-Thouless-type was performed. An improved hierarchical version of the model which displays (unlike the usual Migdal-Kadanoff approach) a stable line of gaussian fixed points at low temperatures, which should correspond to the usual deconfining region of these systems is presented.

4906 **(IFVE-OTF—85-18) Trigonometric solutions of triangle equations and classical Lie algebras.** Bazhanov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700387/JAW.

Submitted to the journal Phys. Lett. .

Six new infinite series of trigonometric solutions of triangle equations are constructed. In the quasi-classical limit, these solutions reproduce the known ones of classical triangle equations for all classical Lie algebras SL(N), SP(N), O(N). 10 refs.

4907 (INIS-mf—11041, pp 161-166) **Renormalization scheme dependence in QCD and QED.** Sakakibara, S. (Mainz Univ., Germany, F.R. Inst. fuer Physik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A brief description of the renormalization scheme dependence problem in quantum chromodynamics as well as in quantum electrodynamics is given. QCD is considered with massless quarks. (M.F.W.).

4908 (INIS-mf—11041, pp 263-272) **On confined QCD.** Baacke, J. (Dortmund Univ., Germany, F.R. Inst. fuer Physik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

A theory of confined QCD is shortly described. The confined propagators, the Casimir energy as well as self energy calculations are discussed in detail. (A.S.).

4909 (INIS-mf—11041, pp 273-288) **Transition from nuclear matter to quark matter.** Cleymans, J. (3727500BE). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

High energy heavy ion collisions which offer the unique possibility of observing the formation of quark matter are discussed. Thermalization is possible if the particles scatter off each other very often and for this to happen they must be produced with a certain transverse momentum. It is necessary to accelerate heavy ions to reach the phase transition point. Heavy lepton pairs escape from the plasma immediately after formation and thus give information about the parameters of the plasma. (M.F.W.).

4910 (INIS-mf—11041, pp 317-334) **Dynamical resolution of the U(1) problem in QCD.** Scadron, M.D. (International Centre for Theoretical Physics, Trieste, Italy). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The nonperturbative and perturbative aspects of the U(1) problem are discussed and linked to the dynamical breakdown of chiral symmetry in QCD. Then a U(1) gap equation is obtained and is approximately saturated with two-gluon intermediate states corresponding to the U(1) anomaly and consistent with eta-eta' mixing.

4911 (INIS-mf—11041, pp 335-341) **Tunneling with fermions.** Leinaas, J.M. (Oslo Univ., Norway. Fysisk Inst.). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The effect of fermionic zero modes on instanton configurations is examined, within some simple quantum mechanical models. Standard arguments based on the vanishing fermionic functional de-

terminant are shown not to lead to the correct result. In particular, with a topological Θ-term, the Θ-dependence may survive the fermionic zero modes. Connection with Yang-Mills theories is briefly discussed.

4912 (INIS-mf—11041, pp 343-347) **Rubakov effect.** Nahm, W. (Bonn Univ., Germany, F.R. Physikalisches Inst.). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

GUT theories, which unify the presently observed gauge interactions into the gauge interaction of a simple gauge group G, predict both the existence of heavy magnetic monopoles and the spontaneous decay of protons and bound neutrons. It has been observed that magnetic monopoles should catalyze nucleon decay with a strong cross section. An elementary description of this effect is presented. (M.F.W.).

4913 (INIS-mf—11041, pp 457-461) **Natural relations and Appelquist-Carazzone decoupling theorem.** Grzadkowski, B.; Krawczyk, P.; Pokorski, S. (Warsaw Univ., Poland. Inst. Fizyki Teoretycznej). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symp ium of elementary particles; Kazimierz, Poland (30 May 1983).

The violation of the Appelquist-Carazzone decoupling theorem in the presence of the natural zeroth order relations is investigated. In this context heavy fermion effects in the Glashow-Salam-Weinberg model are discussed.

4914 **(NBI-HE—87-01) Regularized bosonic strings need extrinsic curvature.** Ambjoern, J.; Durhuus, B. (Niels Bohr Inst., Copenhagen (Denmark)). Jan 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750449/JAW.

We show that the string tension in a class of triangulated random surface models with gaussian action does not tend to zero at the critical point. This rules out the existence of a non-trivial continuum limit of these models. Furthermore, the proof seems to lead to the conclusion that the most natural (if not only) way to avoid this feature of random surface models is by introducing asymptotically free interactions depending e.g. on the extrinsic curvature of the surface.

4915 **(NBI-HE—87-24) Simplifying and extending R/sup */-operation.** Chetyrkin, K.G. (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Apr 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750202/JAW.

We describe how a recursive procedure to subtract all kinds of divergences (including the infrared ones) which can appear in a Euclidean Feynman integral - the R/sup */-operation - can be both simplified and generalized by reformulating it in terms of the standard Bogoluibov-Parasiuk R-operation alone. The new formulation enjoys at least two advantages over the initial one. irst, it is applicable to evaluating ultraviolet divergences for arbitrary two-dimensional models - the problem which lies somewhat beyond the scope of the original version of the R/sup */-operation. Second, with all qualifications about the pattern of external momenta being removed the reformulated R/sup */-operation should be a convenient tool to treat asymptotic behaviour of an Euclidean Green function when some of its external momenta and/or masses tend to infinity.

4916 **(NBI-HE—87-26) Cheshire Cat principle for hybrid bag models.** Nielsen, H.B. (Niels Bohr Inst., Copenhagen (Denmark)). May 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750190/JAW.

The Cheshire Cat point of view where the bag in the chiral bag model has no physical significance, but only a notational one is argued for. It is explained how a fermion - in, say, a 1+1 dimensional exact Cheshire Cat model - escapes the bag by means of an anomaly. The possibility to construct sophisticated hybrid bag models is suggested which use the lack of physical significance of the bag to fix the many parameters so as to anyway give hope of a phenomenologically sensible model.

4917 **(NBI-HE—87-28) Spontaneous emergence of gauge symmetry.** Nielsen, H.B.; Brene, N. (Niels Bohr Inst., Copenhagen (Denmark)). May 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750191/JAW.

Within the framework of the random dynamics project we have demonstrated several mechanisms for breakdown of a preexisting exact gauge symmetry. This note concerns and reviews a mechanism which works essentially in the opposite direction, leading from am accidental approximate symmetry to an exact formal gauge symmetry. It was shown that although this symmetry is a priori only strictly formal, it can under certain circumstances lead to a physical consequence: the corresponding gauge boson becomes massless. In the chaotic models typical for our random dynamics project there is, of course, a strong competition between this mechanism and mechanisms which temd to destroy the symmetry and give mass(es) to the gauge boson(s).

4918 **(NBI-HE—87-29) Quantum field theory with infinite component local fields as an alternative to the string theories.** Krasnikov, N.V. (Niels Bohr Inst., Copenhagen (Denmark)). May 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750193/JAW.

We show that the introduction of the infinite component local fields with higher order derivatives in the interaction makes the theory completely ultraviolet finite. For the γ/sub 5/-anomalous theories the introduction of the infinite component field makes the theory renormalizable or superrenormalizable.

4919 **(NBI-HE—87-35) Covariant loop-calculus for the closed bosonic string.** Petersen, J.L.; Sidenius, J.R. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750450/JAW.

A previously suggested N-reggeon (N-string) amplitude based on the BRST-formulation is extended by obtaining integrations over Koba-Nielsen-like variables in terms of integrations over quasiconformal ghost fields. Simple sewing rules for reggeons are set up and the N-reggeon amplitude is shown to factorize correctly and to have satisfactory BRST-cohomology properties. Multi-loop amplitudes for arbitrary external states are constructed in the Schottky parametrization. The sewing prescription for antighost zero-modes produces a measure on Schottky space with the characteristic BRST properties. The treatment is inherently local on moduli space, however. (orig./HSI).

4920 **(NBI-HE—87-39) Monte Carlo simulations of regularized bosonic strings.** Ambjoern, J.; De Forcrand, P.; Koukiou, F.; Petritis, D. (Niels Bohr Inst., Copenhagen (Denmark); Niels Bohr Inst., Copenhagen (Denmark)). Jun 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750195/JAW.

The world sheet of the bosonic string is regularized by triangulation. The correspondig statistical theory of trinagulated random surfaces is simulated by Monte Carlo methods and the critical exponent γ for the susceptibility determined. A careful analysis of the systematic and statistical errors reveals that we have to wait for the next generation of computers before a high precision measurement of γ is possible.

4921 **(NBI-HE—87-44) Field redefinitions and Chern-Simons terms in the heterotic string.** Bern, Z.; Shimada, T. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750452/JAW.

Field redefinitions in the low energy effective action of the heterotic string are discussed. A field redefinition is constructed which generates the local counterterm that transforms the Lorentz into the gravitational form of the anomaly. We also discuss the field redefinition which torsionizes the Lorentz Chern-Simons term and its relation to an amplitude matching study of the compatibility of torsion with the Gauss-Bonnet combination.

4922 (NORDITA—87/23-P-Prepr.) Renormalization group equations in the stochastic quantization scheme. Pugnetti, S. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); International School of Advanced Studies, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). 28 Apr 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750201/JAW.

We show that there exists a remarkable link between the stochastic quantization and the theory of critical phenomena and dynamical statistical systems. In the stochastic quantization of a field theory, the stochastic Green functions coverge to the quantum ones when the frictious time goes to infinity. We therefore use the typical techniques of the Renormalization Group equations developed in the framework of critical phenomena to discuss some features of the convergence of the stochastic theory. We are also able, in this way, to compute some dynamical critical exponents and give new numerical valuations for them.

4923 (NORDITA—87/29-P-Prepr.) Infinite number of conserved charges and the N-string vertex. Di Vecchia, P.; Hornfeck, K.; Yu, M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Niels Bohr Inst., Copenhagen (Denmark)). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750200/JAW.

We show that the N-string vertex is annihilated by an infinite number of charges corresponding to a symmetry of the string theory.

4924 (RAL—86-103) Topological fluctuations and susceptibility in SU(3) lattice gauge theory. Hoek, J.; Teper, M.; Waterhouse, J. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750209/JAW.

The topological charge density of the (Monte Carlo generated) SU(3) vacuum is measured. The algorithm involves first smoothening the generated configurations in a way that conserves the total charge in the continuum limit. It is found that the topological susceptibility scales like the string tension (within errors). This allows one to extract a value in physical units, Xsub(t)sup(1/4) 191 +- 16 MeV, in good agreement with the Witten-Veneziano mass formula. It is also shown how Xsub(t) is strongly suppressed as the temperature is increased through the deconfining transition, so that the Usub(A)(1) symmetry is effectively restored in the deconfined phase. A variety of calculations are performed -reproducibility; stability under Monte Carlo; distribution of core sizes; etc. -which give one a direct insight into the approach to continuum topology.

4925 (UWThPh—1987-17) Supergravity solitons. 1. General framework. Aichelburg, P.C.; Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700072/JAW.

An outline for the construction of an effective theory of interacting solitons in N = 2 supergravity is presented. The solitons are described by their asymptotic properties, carrying translational and supertranslational degrees of freedom. We discuss briefly the classical and the quantized dynamics for the free soliton. The Lagrangian for the motion of a soliton in a curved supergravity background is exhibited and its implications for an effective supercharge interaction are mentioned.

4926 (UWThPh—1987-18) Quantization of fermions interacting with pointlike external fields. Falkensteiner, P.; Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700073/JAW.

Second quantization of a four parameter family of Dirac operators interacting with pointlike fields leads to inequivalent representations of the CAR. Implementability of gauge transformations gives quantization conditions. We determine the algebra of charges, identify the Schwinger term and work out a connection between the Fredholm index and the winding number.

4927 (UWThPh—1987-20) Supergravity solitons. 2. The free case. Aichelburg, P.C.; Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700075/JAW.

The Langrangian for a single free soliton in N = 2 supergravity as proposed in an earlier paper, is studied. We analyze the algebra of constraints and discuss the local gauge symmetry due to the existence of first class constraints. The classical motion as well as a Gupta-Bleuler type quantization are given.

4928 (UWThPh—1987-22) Supergravity solitons. 3. The background problem. Aichelburg, P.C.; Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700077/JAW.

The motion of a soliton in a supergravity background configuration is studied. The dynamics of the soliton is desribed by a trajectory in curved N = 2 superspace. For the proposed Langrangian the moments, the constraints and the generators of local supertranslations are displayed. An additional local gauge symmetry is exhibited. Special emphasis is laid on the classical equations of motion. These turn out to be a supersymmetric generalization of Papapetrou's equation of motion for a spinning particle in a gravitational field.

4929 (UWThPh—1987-24) Supergravity solitons. 4. Effective soliton interaction. Aichelburg, P.C.; Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700079/JAW.

In previous work solitons of N = 2 supergravity were described as test particles in an external supergravity field. In the present paper we derive the effective interaction of two solitons by inserting a classical soliton configuration for the background into the Lagrangian and apply a slow-motion and large-distance approximation. We obtain the interaction potential to lowest order that incorporates the effect of the supercharge. The resulting classical system is quantized and, as a final step, an effective quantum field theory is formulated.

4930 Probabilistic derivation of parton splitting functions. Durand, L.; Putikka, W. (Physics Department, University of WisconsinMadison, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2840-2845(1 Nov 1987).

We show that the parton splitting functions defined by Altarelli and Parisi can be derived in a completely probabilistic manner. In this approach, the apparent infrared divergences in the Altarelli-Parisi calculation cancel between gain and loss terms in the splitting functions, and momentum and quark quantum number conservation are satisfied automatically without the imposition of extra constraints. We discuss the relation of the probabilistic approach to the usual leading-logarithm diagrammatic analysis.

4931 Bethe-Maximon result. Blankenbecler, R.; Drell, S.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **36**: No. 9, 2846-2849(1 Nov 1987). Contract AC03-76SF00515.

We develop and illustrate a very simple eikonal technique in the framework of one-particle quantum mechanics for calculating radiation during scattering and apply it to derive the celebrated result of Bethe and Maximon for bremsstrahlung from a point Coulomb target with a large charge Ze. This approach is a modification of that developed in a previous paper for calculating radiation during the collision of electron-positron beam pulses (beamstrahlung). The differences in the physics of scattering from a localized target and from an extended target are clarified. A second reason for the present note is the simplicity of our method and its possible extension to other processes.

4932 **Narrow e^+e^- peaks in heavy-ion collisions and a possible new phase of QED.** Caldi, D.G.; Chodos, A. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 9, 2876-2879(1 Nov 1987).

Motivated by the otherwise inexplicable e^+e^- peaks observed in heavy-ion collisions at GSI, we postulate the existence of a new phase of QED. The transition to this new phase is induced by the presence of unusual background electromagnetic field environments. Strong-coupling calculations of the spectrum of confined QED are reported, and the masses fit well with observed peaks.

4933 **String calculation of Fayet-Iliopoulos D-terms in arbitrary supersymmetric compactifications.** Atick, J.J.; Dixon, L.J.; Sen, A. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Physics* [*Section*] *B;* **292**: No. 1, 109-149(21 Sep 1987). Contract AC03-76SF00515.

We calculate the Fayet-Iliopoulos D-terms generated at one loop for the heterotic string in any background which preserves four-dimensional space-time supersymmetry and maintains (2,0) world-sheet superconformal invariance. Although our calculation is performed in the full string theory, the result can be evaluated entirely in terms of properties of the massless spectrum. Furthermore it agrees with the result of a computation in the four-dimensional effective field theory using a stringy regularization. We also check our general result through a more explicit calculation in an orbifold background.

4934 **Representing functionally the two-dimensional conformal group.** FLoreanini, R. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Annals of Physics (New York);* **178**: No. 2, 227-247(Sep 1987).

Projective representations of the two-dimensional conformal group are explicitly constructed in terms of propagation kernels. The representation functionals are then used to study the effect of conformal transformations on the states of a free massless scalar field theory. copyright 1987 Academic Press, Inc.

4935 **Coordinate-invariant regularization.** Halpern, M.B. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Annals of Physics (New York);* **178**: No. 2, 272-312(Sep 1987). Contract AC03-76SF00098.

A general phase-space framework for coordinate-invariant regularization is given. The development is geometric, with all regularization contained in regularized DeWitt Superstructures on field deformations. Parallel development of invariant coordinate-space regularization is obtained by regularized functional integration of the momenta. As representative examples of the general formulation, the regularized general non-linear sigma model and regularized quantum gravity are discussed. copyright 1987 Academic Press, Inc.

4936 **Functional determinants on Riemann surfaces.** Dugan, M.J.; Sonoda, H. (California Univ., Berkeley, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA). *Nuclear Physics* [*Section*] *B;* **289**: No. 1, 227-252(20 Jul 1987). Contract AC03-76SF00098.

We compute the functional determinant of the laplacian acting on n-differentials (n is a half-integer) on an arbitrary Riemann surface of genus $g>1$. We first compute the propagator of the corresponding fermionic field theory and obtain the energy-momentum tensor. Then we integrate the energy-momentum tensor to obtain the functional determinant.

4937 **Perturbative analysis of Rebbi's lattice fermion proposal.** Bodwin, G.T.; Kovacs, E.V. (Argonne National Lab., IL, USA. High Energy Physics Div.; Illinois Univ., Chicago, USA. Dept. of Physics). *Physics Letters* [*Section*] *B;* **193**: No. 2/3, 283-291(16 Jul 1987). Contract W-31-109-ENG-38.

We analyze, in the context of weak-coupling perturbation theory, the recent proposal of Rebbi for incorporating fermions into lattice gauge theory. In spite of the chiral symmetry of the Lagrangian, we find that, in four dimensions, the fermion develops a dynamically generated mass. The vacuum polarization and the anomaly in two dimensions display spectrum doubling.

4938 **Experimental evidence for quantum gravity?.** Goldman, T.; Hughes, R.J.; Neitro, M.M. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 434-435(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A broad range of quantum field theories of gravity predict the existence of vector and scalar components of gravity in addition to the usual tensor component. These may produce effects observable at the classical level. We refer to experimental results suggestive of the appropriate effects and show that a clear, low-energy test of these theories may be made by measuring the gravitational acceleration of antiprotons in the Earth's field.

4939 **Lattice gauge theory as a nuclear many-body problem.** Mathews, G.J.; Bloom, S.D.; Snyderman, N.J. (University of California, Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 791-795(15 Oct 1986). (CONF-860575—). Contract W-7405-ENG-48.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We discuss the conceptual connection between lattice quantum chromodynamics and a nuclear many-body problem. We begin with an illustrative example of how the 0(3) nonlinear sigma model in (1+1) dimensions can be computed with a nuclear shell-model code with a speed which is competitive with other approaches. We then describe progress toward the implementation of this technology in lattice SU(2) Yang-Mills gauge theory.

4940 **Solving QCD using Monte Carlo renormalization group method.** Gupta, R.; Patel, A. (Physics Dept., Northeastern Univ., Boston, MA 02115). pp 302-305 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The need for the use of Monte Carlo Renormalization Group method for solving QCD is stressed. MCRG results for the non-perturbative β-function and the improved action for SU(3) are presented using the $\sqrt{3}$ blocking transformation. The existing Monte Carlo results are analyzed to check for scaling in the range of couplings in which the β-function shows a dip. Finally a status report of MCRG calculations using an improved action is given.

4941 **Lattice overview.** Creutz, M. (Brookhaven National Lab., Upton, NY 11973). pp 297-301 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—). Contract AC02-76CH00016.

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

After reviewing some recent developments in supercomputer access, the author discusses a few areas where perturbation theory and lattice gauge simulations make contact. He concludes with a brief discussion of a deterministic dynamics for the Ising model. This may be useful for numerical studies of nonequilibrium phenomena.

4942 **Experimental tests of new SO(10) grand unification.** Marshak, R.E.; Gipson, J.; Parida, M.K.; Chang, D.; Mohapatra, R.N. (Virginia Polytechnic Institute, Blacksburg, VA 24061). pp 320-321 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Two-loop contributions are calculated for the various symmetry-breaking chains in the new approach to SO(10) grand unification wherein D parity breaking is decoupled from SU(2)/sub R/ breaking. A unique chain emerges if one imposes a minimality condition and the phenomenological requirements of tau/sub p→e/ + /sub π/0 ≧ 2 x 10/sup 32/ years, sin/sup 2/θ/sub W/(M/sub W/)=0.22 +- 0.02 and α/sub s/ (M/sub W/) = 0.10 - 0.12. This chain allows for the following detectable consequences: (a) neutron oscillations with tau/sub nn-bar/ — 10/sup 8/ - 10/sup 9/ sec; (b) a branching ratio for K/sub L/ → μe-bar of 7 x (10/sup -8/-10/sup -12/); (c) a second neutral Z/sub R/ boson in the 1/2 to 10 TeV range; (d) a proton lifetime tau/sub rho/ = 6.5 x 10/sup 35+-.9/ (Λ/sub M-barS//160 MeV)/sup 4/ years; (e) a Majorana mass for the electron neutrino in the range of electron volts. This experimentally interesting chain satisfies all cosmological constraints.

4943 **Cosmology in theories with extra dimensions.** Kolb, E.W. (Theoretical Astrophysics, Fermi National Accelerator Lab., Batavia, IL 60510). pp 101-109 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Some possible cosmological effects of the existence of extra compact dimensions are discussed. Particular attention is given to the possibility that extra dimensions might naturally lead to an inflationary Universe scenario.

4944 **If there are no axions, is the universe closed.** Cahill, K. (Univ. of New Mexico). pp 350 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

If the universe is closed, as in the standard model with k=+1, then there is no strong CP problem. The reason is that Guass's law forces the QCD vacuum angle θ to be zero when the spatial universe has no boundary. Other solutions to this problem require either axions or a massless quark. A massless quark is not indicated by current algebra. Experimental searches and astrophysical arguments seen to have ruled out axions apart for those with a decay constant in the range 10/sup 8/GeV<f/sub a/<10/sup 12/ GeV. The author therefore faced with the following choices: either (1) such axions do exist or (2) the universe is closed or (3) current algebra is incomplete or (4) there is another resolution of the strong CP problem. A search for axions in the remaining range of f/sub a/ would be of great interest.

4945 **On CP-violation in SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models.** Herczeg, P. (Theor. Div., LANL). pp 350 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

CP-violation in electroweak models based on the gauge group SU(2)/sub L/ x SU(2)/sub R/ x U(1) is discussed. The author shows that if no other constraints than phenomenological ones are imposed on the parameters of these models, ξ'/ξ/sub expt/ due to W/sub L/ - W/sub R/ mixing could be as large as the present experimental limit. Some other effects of W/sub L/-W/sub R/ mixing are also considered.

4946 **Saturation and nonlinear evolution of parton distributions at small x.** Durand, L. (Physics Dept., Univ. of Wisconsin-Madison). pp 353 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Recently pointed out by other investigators that interactions between partons become important in the QCD evolution of structure functions when the parton density becomes sufficiently high that partons of a given size begin to overlap. The usual Altarelli-Parisi approach to the evolution fails in this situation. The author shows that the high-density evolution can be described physically by nonlinear evolution equations, and estimate when the nonlinearity must be included. The nonlinear effects are most important for gluon distribution at small x.

4947 **Projector Monte Carlo study of string tension and roughening in lattice QED/sub 3/.** De Grand, T.A.; Potvin, J. (Univ. of Colorado). pp 354 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors report on a study of string properties in Abelian lattices gauge theory in 2 + 1 dimensions. They use an improved version of a method initially proposed by Blankenbecler and Sugar, based on the observation that the operator exp(-βH) projects onto the ground state. They have calculated the ground state, string energies and string tension, in the coupling range 0.57≦g≦ 2.00 on a 6/sup 2/ lattice. Also investigated is the string width, for which the coupling dependence is shown to be consistent with an earlier investigation, and with the existence of a roughening transition at g— 1.16.

4948 **Finite-element gauge theory.** Milton, K.A. (Oklahoma State Univ.). pp 354 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The finite-element method provides a naturally consistent prescription for putting operator field theory on a space-time lattice. When Abelian gauge invariance is implemented, a non-local interaction is induced which breaks chiral symmetry. The chiral symmetry breaking mass is computed in the Schwinger model for M space lattice sites; the error falls off as M/sup -2/. The implementation of non-Abelian gauge invariance is discussed.

4949 **Hadron wave functions in lattice QCD.** Velikson, B.; Weingarten, D. (IBM, Yorktown Heights). pp 354 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Coulomb gauge quark-antiquark wave functions for the pion and the rho are calculated in the valence approximation on a lattice 8/sup 3/ x 16. The authors use gauge group SU(2) at β of 2.431 corresponding to an inverse lattice spacing of 1100+- 100MeV. The wave functions fall off significantly over the size of the box, are rotationally invariant except at the box's boundary, and are nearly independent of the lagrangian quark mass.

4950 **Path integrals without lattices for QED/sub 2/.** Reeder, R.; Cahill, K.; Prasad, S. (Univ. of New Mexico). pp 354 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

One can approximate path integrals in free two-dimensional quantum electrodynamics by expanding the fields in terms of a complete set of functions, by truncating the expansion, and by using Monte-Carlo techniques to evaluate the resulting finite-dimensional integrals. By using 3,131 functions of compact support, the authors computed the Wilson-loop functional to an accuracy of 8 to 14% for reasonably sized loops. Thee results changed by less than 6% when they delayed the loops by one-tenth of the duration of the model universe.

4951 **Can baryons be chiral solitons in the effective Lagrangian of the non-linear SU(N) σ quark model.** Chan, L.H. (Louisiana State Univ.). pp 352 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author presents the calculation of the effective Lagrangian for the non-linear SU(N) σ model in the one quark loop approximation up to terms containing four derivatives. In addition to the Wess-Zumino term, he finds the remaining terms containing four derivatives different from the Skyrme Lagrangian. This Lagrangian has no arbitrary constant. This possibility of supporting soliton solutions by the Lagrangian is discussed.

4952 **Not so invisible axion.** Sikivie, P. (Physics Department, University of Florida, Gainesville, Florida 32611). *AIP (American Institute of Physics) Conference Proceedings;* 114: No. 1, 184-188(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

Experimental detection of the postulated axion may be possible, thus explaining P and CP invariance by the strong forces. The possibility of experimentally verifying the existence of the axion is discussed. (AIP)

65 PHYSICS II

REFER ALSO TO CITATION(S) 5337

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 4682, 4705, 4706, 4707, 4709, 5079

4953 **(CEA-CONF—8934) Hypernuclei production from elementary hadronic and electromagnetic probes.** Lemaire, M.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Nov 1986. 27p. (In French). (CEA-DPH-N-S—2421; CONF-861142—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753237/JAW.

From US/FR workshop on tritiated waste, immobilization, packaging and incineration; Cadarache, France (12 Nov 1986).

First, a brief recall of the knowledge on hypernuclei from the (K/sup -/, π/sup -/) experiments studied at the CERN, Brookhaven and at KEK is presented. The studies, being now developed in these same laboratories, are presented. The second part deals with the study of hypernuclei from the (π/sup +/, K/sup +/) reaction. The first results of Brookhaven are given. Then, one discusses the possibilities of studying hypernuclei from the reactions (p,K/sup +/) and (p,pK/sup +/), (γ,K/sup +/) and (e,e'K/sup +/).

4954 **(CEA-N—2510) Progress report of the Nuclear Physics Department.** (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1987. 324p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88750271/JAW.

This progress report presents the experiments and the technological studies carried out at the Nuclear Physics Department of Saclay from October 1, 1985 to September 30, 1986. These studies concern the structure of nuclei, the nuclear reaction mechanisms and, more and more, mesic processes in nuclear dynamics. The experiments have been carried at the 700 MeV electron linac, the synchrotron SATURNE, the heavy ion accelerator GANIL, the SARA facility at Grenoble. An important technical activity has been devoted to the construction of the supraconducting booster of the 9 MV tandem.

4955 **(DOE/ER/02197—T2) Hadronic atoms: Technical progress report, February 1, 1984-January 31, 1985.** Kunselman, R. (Wyoming Univ., Laramie (USA)). 1985. Contract AC02-76ER02197. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002145/JAW.

The main efforts on hadronic atoms for 1983 have been on experiments at LAMPF, BNL, AND TRIUMF. The experiments have involved atoms with pions, kaons, and sigma-minus particles.

4956 **(GSI—87-1) GSI scientific report 1986.** Grundinger, U. (ed.). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1987. 449p. NTIS (US Sales Only), PC A19/MF A01. Order Number DE88750444/JAW.

This annual report contains extended abstracts about the work performed at the named institute concerning nuclear physics, atomic physics, radiation effects, and developments in counting techniques, and accelerator technology, as well as a list of publications, conference contributions, seminars, and lectures.

4957 **(GSI—87-10) High energy nuclear collisions. The GSI-LBL-Collaboration at the BEVALAC: Papers 1975-1987.** Gutbrod, H.H.; Sandoval, A.; Stock, R. (eds.). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 802p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.

This report contains a collection of reprints of publications from the two GSI-LBL collaborations at the Bevalac accelerator in Berkeley. They deal with relativistic heavy ion reactions with special regard to the study of compressed hot nuclear matter. (HSI).

4958 **(IFUSP-P—648) Identification of projectile sequential decay and transfer-reemission reactions channels in the /sup 16/O+/sup 28/Si, /sup 16/O+/sup 27/Al and /sup 10/B+/sup 27/Al systems at 4-5 MeV/A .** Carlin Filho, N.; Coimbra, M.M.; Added, N.; Anjos, R.M. dos; Fante Junior, L.; Figueira, M.C.S.; Guimaraes, V.; Szanto, E.M.; Toledo, A.S. de; Civitarese, O. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700369/JAW.

In plane angular correlations have been investigated in the /sup 28/Si (/sup 16/O, /sup 12/C-α), /sup 27/Al(/sup 16/O, /sup 12/C-α) and /sup 27/Al (/sup 10/B,/sup 6/Li-α) reactions at 64,64 and 48 MeV, respectively. Two sequential processes have been identified, namely: transfer-reemission through the formation of intermediate nuclei and projectile sequential decay. The analysis is based on three body kinematics and model fits of experimental angular correlation functions.

4959 (INIS-mf—10996, pp 30-36) **Evaluation of (N,N') cross sections for formation of isomeric states at E/sub N/ = 14 MeV and study of their systematic dependence on spin.** Vonach, H. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4960 (INIS-mf—10996, pp 36-37) **Evaluation of secondary neutron emission cross sections.** Pavlik, A.; Vonach, H.; Tagesen, S. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

4961 (INIS-mf—11041, pp 297-302) **Multiplicities in high p/sub T/ hadron-nucleus interactions.** Naumann, Th. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Preliminary data from interactions of a 40 GeV/c negative beam with C, Cu and Pb in the 5m Dubna streamer chamber RISK are presented. A single particle trigger selects events in the central region -0,2<x/sub F/<0,0 with p/sub t/>1,2 GeV/c. The effect of this trigger on the multiplicities of charged particles and protons is shown.

4962 **(IPNO-RA—1985) IPN. Annual progress report. 1 September 1984-30 August 1985.** (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1985. 222p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750088/JAW.

This report presents the work of the year 1985 of research in the Division of experimental physics of the Institute of Nuclear Physics in Orsay, the activities are conducted in six axes: nuclear structure, high excitation energy nuclear states, heavy ion collision phenomena, intermediate energy nuclear physics, radiochemistry and perinuclear research. The second part presents the studies of the theoretical physics division of the Institute for Nuclear Physics in Orsay in 1985. The different research axes are the following: nuclear physics, intermediate energy nuclear physics, elementary particles. A compilation of publications of meetings of the year is finally given.

4963 **(JYFL-RR—2/86) Electronic factors for K-shell-electron conversion probability and electron-positron pair formation probability in electric monopole transitions.** Passoja, A.; Salonen, T. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Apr 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753040/JAW.

This paper presents, in tabular form, the electronic factors Ω/sub K,π/(Z,k) of the electric monopole transition probability associated with the internal conversion of an electron from the atomic K shell (IC;K) and with the internal pair formation(IPF;π). The Ω/sub π/ values are calculated by taking the nuclear Coulomb effects into account. The corrections to Ω/sub K/ due to finite nuclear size and bound-state atomic screening are not included in the present calculations. The calculated ratio of the K-shell-electron conversion probability to the electron-positron pair formation probability is found to be in good agreement with the available experimental data for Z-<40.

4964 (LA—10956-C, pp 62-80) **LEP physics program.** Roos, P.G. (Univ. of Maryland, College Park). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

This talk will be a very brief survey of the experiments carried out over the past couple of years and those to be carried out during the next year or two. The LEP channel is a versatile channel covering the energy range from ~10 MeV to ~300 MeV π/sup +/-/ with adequate quality (e.g., energy resolution, phase space, and beam contamination) and flux to address a wide range of physics questions. Unlike some channels the program is not dominated by the presence of a single major instrument. As a result the authors have a balanced and interesting program which addresses essentially all aspects of pion-nucleus physics in this energy range.

4965 (LA—10956-C, pp 81-101) **Physics at the Nucleon Physics Laboratory.** Axen, D. (Univ. of British Columbia, Vancouver). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

Experimental programs at NPL are diverse and evolving rapidly. Some of these programs are illustrated in this paper. Nucleon-nucleon experiments are emphasized. Evidence from these indicates that complete determination of the inelasticities for all the amplitudes will be necessary. A 4-pi experiment to study proton-antiproton annihilation which was conducted at CERN is described and techniques for amplitude analysis of three particle final states are discussed. It is argued that a program for studying multiparticle final state reactions with a 4-pi detector would be interesting for the Advanced Hadron Facility.

4966 **(PCCF-T—86-03) Measurement and analysis of large momenta in nuclei.** Force, P. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Jun 1986. 117p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750240/JAW.

Backward energetic proton cross sections are measured from 200 MeV proton beam on various targets. Data are analysed using the Quasi Two Body Scaling frame (single scattering on a nucleon). A scaling rule is found for large momenta. A (p-γ) coincidence experiment is performed to identify the residual nuclei and the excitation energy in the nuclei is measured. These results are in good agreement with the "Q.T.B.S." Theory. A similar experiment with an electron beam shows the same momentum spectrum. An approach of short range correlation between nucleons is proposed. 35 refs.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 4141, 4795, 4984, 4985, 5101, 5115

4967 **(CEA-CONF—8976) Electromagnetic probe in nuclear physics: future experiments and future accelerators.** Bergere, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Mar 1987. 8p. (CEA-DPH-N-S—2422T; CONF-8703177—4-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750102/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

This text summarizes the main ideas and facts of what will be presented in oral presentation. The physics program of electromagnetic interaction on nuclei is shown. A panorama of the future electron accelerators is given.

4968 **(GANIL—87-17) Mass and radius of nuclei far from stability.** Schutz, Y.; Mittig, W.; Gillibert, A. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). May 1987. 20p. (CONF-8705201—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750460/JAW.

From 22. Zakopane school of physics; Zakopane, Poland (1 May 1987).

Four questions are answered in this lecture: how are nuclei far from stability produced and identified using heavy ion beams with intermediate energies; what can be learned from systematic measurements of ground state masses of exotic nuclei; how is the mass measured with high accuracy using a magnetic spectrometer, what are the results obtained so far.

4969 (LA—10956-C, pp 132-140) **Nuclear chemistry at LAMPF.** Porile, N.T. (Purdue Univ., West Lafayette, IN). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The nuclear chemistry activities at LAMPF currently involve 12 experiments that can be grouped into three categories: (1) atomic mass measurements with the TOFI spectrometer, (2) pion-nucleus interactions, and (3) cosmo-chemistry. The experiments are each briefly described.

4970 **Fundamental interaction studies in nuclei.** Haxton, W.C. (Institute for Nuclear Theory, Department of Physics, FM-15, University of Washington, Seattle, WA 98195). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 738-748(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

There is a growing class of nuclear and atomic physics experiments in which the special properties of many-body systems are exploited in tests of fundamental symmetries. Three representative topics are discussed: parity nonconservation in the N N interaction, time-reversal-odd nuclear moments, and matter-enhanced neutrino oscillations.

4971 **Direct lepton production in hadronic and nuclear collisions at low pt and low pair mass.** Roche, G. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 806-813(15 Oct 1986). (CONF-860575—). Contract AC03-76SF00098.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief review of the direct production of single leptons and dileptons in hadronic collisions at low pt and low pair mass is given. Several open questions are pointed out and the universality of lepton production is briefly discussed. The Bevalac Di-Lepton Spectrometer project is presented.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

4972 **(CEA-CONF—8971) High momentum proton distribution and short range correlations in helium 3.** Marchand, C.; Bernheim, M.; Gerard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Mar 1987. 8p. (In French). (CEA-DPH-N-S—2423; CONF-8703177—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750101/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

By means of a /sup 3/He(e,e'p) experiment, we have measured the exclusive electron scattering cross sections on /sup 3/He for recoil momenta ranging from 300 to 600 MeV/c. In the frame of PWIA analysis, we obtain the proton momentum distributions for both the p-d and p-pn channels from 300 to 600 MeV/c. We also show a clear evidence for the presence of short-range nucleon-nucleon correlations in the p-pn channel.

4973 **(CEA-CONF—8973) Recent results of the nucleon-nucleon program at Saturne 2.** Perrot, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Mar 1987. 13p. (CEA-DPH-N-S—2412; CONF-8703177—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750110/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Recent results of measurements of p-p spin dependent observables are presented and discussed. These results allowed to extend the pp phase-shift analysis up to 1.3 GeV. They cast doubts on the possibility of a resonance in the /sup 3/F/sub 3/ partial wave, but on the contrary confirm possible broad resonances in /sup 3/P/sub 2/, /sup 1/D/sub 2/ and /sup 1/G/sub 4/ partial waves. Preliminary data of spin correlation parameters and analysing power in np elastic scattering, as well as spin dependent total cross sections $\Delta\sigma$/sub T/ and $\Delta\sigma$/sub L/ (np) are presented.

4974 **(CEA-CONF—8975) Electroproduction of π/sup +/ at the threshold on the nucleon.** Bensayah, N.; Berthot, J.; Bardin, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Mar 1987. 18p. (In French). (CEA-DPH-N-S—2428B; CONF-8703177—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750112/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

The π/sup +/ electroproduction near the threshold on the nucleon, with separation of transverse and longitudinal parts of cross sections is presented. Dependence of nucleon axial form factor, as a function of the virtual photon quadrimoment, can be deduced up to 20(fermi)/sup -2/. After a brief theoretical review, the experimental method is shown and problems raised by the high quadrimomenta conclude the article.

4975 **(DOE/ER/40150—35) (e,e'N) reactions.** Mougey, J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 39p. (CEBAF-PR—87-028). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001718/JAW.

With the advent of a new generation of high energy, high duty cycle electron accelerators, a whole range of new nuclear and subnuclear phenomena can be investigated, in particular through coincidence experiments. This contribution focuses on one and two nucleon emission studies below pion threshold. After a brief review of recent experimental and theoretical work, the study of single nucleon densities through high energy (e,e'N) experiments is discussed. New insights in short-range multihadron phenomena are likely to be obtained through (e,e'p), (e,e'd) and (e,e'2N) reactions. Coincidence experiments, some of them involving polarization measurement, are described to study the free and bound nucleon electromagnetic responses. 57 refs., 30 figs., 2 tabs.

4976 **(EFI—902-53-86) Measurement of the cross section of forward Compton scattering on /sub 2//sup 4/He at E/sub γ/=1.8 + 3.8 GeV.** Aleksanyan, A.S.; Babayan, G.E.; Voskanyan, A.V. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700318/JAW.

Differential cross sections of Compton scattering on /sub 2//sup 4/He nuclei at transfer momenta $0.02 \leq t < 0.14$ (GeV/c)/sup 2/ at energy range E/sub γ/=1.8 + 3.8 GeV are measured. On the basis of multiple scattering diffraction theory, the differential cross sections at t=0. The diffraction cone parameters and the radius of /sub 2//sup 4/He nucleus are determined. Experimental values of the phase of the scattering amplitude on nucleon are give. By means of differential cross sections at t=0, the full cross section of photoabsorption and the coefficient of photon shielding on /sub 2//sup 4/He are determined. 11 refs.

4977 **(KFK—4222) Examination of X-ray spectra from the antiprotonic helium isotopes /sup 3/He and /sup 4/He.** Schneider, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). May 1987. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750177/JAW.

Using the high intensity antiprotonic LEAR beam at CERN (Geneva), several measurements were done to investigate the X-ray spectra of the antiprotonic Helium isotopes /sup 3/He and /sup 4/He. For the first time antiprotons were stopped in gases at low pressures (600, 375, 72 and 36 mbar), which permitted observations on nearly isolated atoms. A newly developed method for stopping the antiprotons in gases by means of a focusing cyclotron field surrounding the target gas was used. The field was supplied by a superconducting magnet ('cyclotron trap'). The antiprotons were tangentially injected into the cyclotron field, where they slowed down by ionising the target gas. The inhomogeneous magnetic field guided the antiprotons in spiral orbits to the magnetic center. Thus, even at low pressures a very small stopping volume could be achieved. To detect the X-rays different Si(Li)- and Ge-semiconductor detectors were used, some of which were furnished with 'guard-rings'. They were used to investigate the effects of the strong interaction between the antiproton and the nucleus in the (3d -> 2p) transition in both isotopes. The analyzis of this transition permitted directly the determination of the shift and width of the 2p-level. The width of the 3d-level could be determined only indirectly using an intensity balance. The utilization of gases with different pressures permitted investigations of the pressure dependence of the antiprotonic deexcitation process. The results for the widths and shifts were compared with earlier measurements and theoretical predictions. The theory agrees only partly with the measurements. The evaluation of a complex scattering length using an optical model contradicts some of the results of calculations.

4978 Exploratory gas-target experiment at PEP using the TPC/2γ facility. Dietrich, F.S.; Melnikoff, S.O.; Van Bibber, K.A. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 378-381(15 Oct 1986). (CONF-860575—). Contract W-7405-ENG-48.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We have performed a pilot nuclar-physics experiment at the PEP ring by bleeding deuterium, argon, and xenon gases into the interaction region containing the TPC/2γ racility. The purpose of the experiment was to obtain information for the design of a dedicated nuclear-physics interaction region at PEP, as well as to obtain a first view of the physics that could be studied at such a facility.

4979 Measurements of the deuteron magnetic form factor at high Q^2. Bosted, P.E. (The American University, Washington DC 20016). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 554-558(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We have doubled the range of existing data for the magnetic form factor of the deuteron by making measurements at $Q^2 = 1.5$, 1.75, 2.25, and 2.5 $(GeV/c)^2$. The results show a shallow minimum around $Q^2 = 2$ $(GeV/c)^2$, in qualitative agreement with impulse approximation calculations.

4980 Precision test of charge independence. Seth, K.K.; Artuso, M.; Barlow, D.; Parker, B.; Soundranayagam, R. (Northwestern University, Evanston, IL 60201, USA). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 627-629(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Measurements of pion production from the one-nucleon transfer reactions p+d to tritium + pi-plus p+d to helium-3 + pi-neutral with polarized protons were taken. Asymmetry results are presented fora test determination of charge independence in hadronic interactions.

4981 Eta-meson production experiments at LAMPF. Peng, J.C. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 630-635(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Results of recent experiments on the (π,eta) reactions in nuclei are reported.

4982 Splitting of the roper resonance. Nefkens, B.M.K.; Adrian, S.; Eichon, A.; Engelage, J.; Kim, G.; Ohashi, Y.; Ziock, H.; Arends, J.; Sober, D.; Briscoe, W.; and others. (University of California, Los Angeles, Ca. 90024). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 640-643(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Asymmetry measurements in the reactions pi-minus+p to pi-neutral+n pi-minus+p to gamma+n have been made with a polarized proton target to determine the splitting of the Roper Resonance.

4983 Observation of KNO scaling in the neutral energy spectra from αα and pp collisions at ISR energies. Tannenbaum, M.J. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 858-871(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Neutral transverse energy spectra in pp and αα interactions are analyzed in terms of the Wounded Nucleon Model. Analysis of the αα spectrum by application of a multiple nucleon-nucleon collision mechanism is conveniently performed when a Gamma Distribution is used to represent the pp spectral shape. The Wounded Nucleon Model provides a reasonable description of the αα spectrum for the first 3 orders of magnitude, but completely fails to account for the slope of the high energy tail of the distribution. However, the pp and αα spectra can both be fit to the same Gamma Distribution when scaled by their respective mean values and thus exhibit KNO scaling.

4984 Status of the Los Alamos free atomic tritium beta-decay experiment. Wilkerson, J.F.; Bowles, T.J.; Browne, J.C.; Burritt, T.H.; Cohen, J.S.; Helffrich, J.A.; Knapp, D.A.; Maley, M.P.; Martin, R.L.; Robertson, R.G.H. (Los Alamos National Lab., Los Alamos, NM). pp 247-248 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

An experiment to study the beta-decay of tritium using a gaseous source of free (unbound) atomic tritium is currently underway in the Physics Division at Los Alamos. The use of free atomic tritium along with careful design of the measurement scheme should allow a definitive determination for an electron antineutrino mass —10 eV.

4985 An experiment to measure the electron neutrino mass using frozen tritium. Fackler, O.; Mugge, M.; Sticker, H.; White, R.M.; Woerner, R. (Rockefeller Univ., New York, NY 10021). pp 242-244 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors performed an experiment to determine the electron neutrino mass with the precision of a few eV by measuring the tritium beta decay energy distribution near the endpoint. To make this measurement, they have built a spectrometer with a resolution of 2 eV. Their source is frozen tritium since tritium and the HeT/sup +/ daughter ion have electronic wavefunctions that can be calculated with high accuracy. They describe the experiment and discuss the excited final molecular state calculations.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

4986 (CEA-CONF—8941) Heavy fragments emission from highly excited nuclei. Faure, B.; Auger, F.; Wieleczko, J.P.; Mitting, W.; Cunsolo, A.; Foti, A.; Pascaud, J.M.; Quebert, J.; Plagnol, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Jan 1987. 11p. (CEA-DPH-N-S—2427-2; CONF-870153—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750080/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

In the intermediate energy domain, the high amount of excitation energy and angular momentum deposited in the nuclei allow the emission of fragments heavier than the usual evaporation particles to have a significant cross section. The study of the properties characterizing the production of these fragments could be a good way to investigate the mechanisms which contribute to formation of hot nuclei and the limits for linear momentum and excitation energy deposited in the nucleus, as well as possible deformations related to these high temperatures. These phenomena might depend much on the center of mass energies and angular momenta. In order to analyse these entrance channel effects/sup 3/, we chose to study the following systems: Kr + C, Kr + Al, Kr + Ti at an incident energy of the Kr beam delivered by GANIL of 2216 MeV. 7 figs, 1 tab, 9 refs..

4987 (CEA-N—2506) Neutron elastic and inelastic scattering from /sup 14/N between 7.7 and 13.5 MeV. Houat, G.; Chardine, J.; Seguin, S.; Humeau, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1986. 134p. (In French). (NEANDC(E)—240-L; INDC(FR)—69-L). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750114/JAW.

Differential cross sections are reported for neutron elastic and inelastic scattering from /sup 14/N at incident energies of 7.67 - 7.90 - 8.11 - 9.00 - 10.30 - 10.65 - 11.00 - 11.50 - 12.40 and 13.50 MeV. These data were measured by means of the time-of-flight technique and using a liquid nitrogen scattering sample. The present results are compared to previous data and to the ENDF/B.IV evaluation. Large discrepencies are observed between our data and the ENDF/B.IV evaluation, and suggest a revision of this file. This would help to better understand the problems encountered in neutron transport and dosimetry calculations in the atmosphere.

4988 (GANIL-P—87-18) Multi-processor data acquisition for multi-detectors at GANIL. Clement, J.; Delagrange, H.; Postec, H.; Raine, B.; Tillier, J.; Tripon, M.; Vaillant, D. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). May 1987. 5p. (CONF-870552—28). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750459/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

A modular data acquisition system using MC68xxx microprocessors and VME buses for parallel data read-out and processing is described. It has been designed for a multi-detector system at GANIL but its principles should be easily applied to the conception of other systems. Under construction, it must be operating at the end of 1987.

4989 (ISN—86-71) Elastic scattering of polarized deuterons at intermediate energies. Ye, Y. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1986. 180p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753224/JAW.

Angular distributions of cross section, and A/sub y/ and A/sub yy/ analysing powers were measured for polarized deuteron elastic scattering from /sup 16/O and /sup 58/Ni at 200, 400 and 700 MeV, and from /sup 40/Ca at 700 MeV. The data at 200 MeV show evidence for a nuclear rainbow effect, whereas those at 400 and 700 MeV are reminiscent of the proton scattering result at equivalent energies. The data were analysed in terms of the optical model. The volume integral and the rms radii of the optical potential present a noticeable change above 200 MeV. For /sup 16/O the real central potential shape changes from an attractive Woods-Saxon form at 200 MeV to a wine-bottle-bottom form with a repulsive interior at 700 MeV. The total reaction cross section deduced display a clear nuclear transparency effect in the present energy domain in agreement with predictions from simple microscopic calculations. The optical limit of the Glauber theory is extended to polarised deuteron elastic scattering. The data at 700 MeV are well reproduced by the calculations, emphasizing the predominance of individual nucleon-nucleon interaction at this energy.

4990 (ISN—86-78) On the longitudinal charge response in the quasielastic peak region. Stroth, U.; Hasse, R.W.; Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jul 1986. 2p. (CONF-860741—27). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750247/JAW.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

We calculate for /sup 12/C, /sup 40/Ca, and /sup 56/Fe the charge response for momentum transfers $1.0 < q < 2.$ fm/sup -1/ within a RPA theory which is pushed to highest sophistication presently possible. This is achieved using a semiclassical theory and the finite range and density dependent Gogny force which compares well with microscopic G-matrix calculations up to $q \simeq 1.5$ fm/sup -1/; antisymmetrisation is taken into account in the mean-field and residual interaction. Remaining differences with experiment should then originate from effects not contained in the RPA theory. We find good agreement with experiment for /sup 12/C for the momentum transfers considered but for /sup 40/Ca and /sup 56/Fe the missing charge problem persists. We tentatively conclude that it is the missing coupling to 2p-2h states in the $S = 0$, $T = 1$ part of the response which is responsible for this and give detailed arguments for our speculation. 3 figs; 9 refs.

4991 (ISN—86-98) Elastic scattering of polarised deuterons from /sup 16/O at 200, 400 and 700 MeV. Van Sen, N.; Yanlin, Y.; Arvieux, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Sep 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750248/JAW.

Angular distributions of cross section, and A/sub y/ and A/sub y/y analysing powers were measured for polarised deuteron elastic scattering from /sup 16/O at 200, 400 and 700 MeV. The data at 200 MeV bear evidence of the nuclear rainbow phenomenon while those at 400 and 700 MeV are reminiscent of the proton scattering results at equivalent energies. The data were analysed in terms of the optical model. The real central potential shape changes from an attractive Woods-Saxon form at 200 MeV to a wine-bottle-bottom form with a repulsive interior at 700 Mev. The total reaction cross sections deduced display a clear nuclear transparency effect in the present energy domain agreement with predictions from the Glauber theory optical limit. Comparison with previous results for /sup 40/Ca and /sup 58/Ni targets is made.

4992 (ISN—87-01) Analysis of the /sup 12/C + /sup 12/C inelastic scattering in the energy range 11 - 24 MeV/n. Pham, D.L.; Swiniarski, R. de. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Dec 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750668/JAW.

Elastic and inelastic scattering cross-sections of /sup 12/C + /sup 12/C in the energy range 11 - 24 MeV/n have been analyzed within the coupled channels framework including appropriate symmetrization. Coupled channels calculations have been made to fit the data and it has been found that they require a reduction of the imaginary potential. The total reaction cross-section σ/sub /R(E) determined from this analysis is in good agreement with a direct and recent measurement of σ/sub R/. Quadrupole deformation parameter β/sub 2/ has been extracted and compared with those obtained for proton and alpha scattering. Some small energy dependence of β/sub 2/ over this energy range has been found, /β/sub 2// $\sim$ 0.39 - 0.47. Finally, these calculations further confirm that β/sub 2/ depends on the probe used in the various scattering experiments. For composite projectile such as α or /sup 12/C, β/sub 2/ is clearly smaller than that one for nucleons as projectile.

4993 Sequential breakup cross section of ^{6}Li by /sup 40/Ca. Van Verst, S.P.; Sanderson, D.P.; Kemper, K.W.; Shapira, D.; Varner, R.L.; Shivakumar, B. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1865-1869(Nov 1987).

The differential cross section for the excitation of the unbound 3^+ (2.18 MeV) state in ^{6}Li was measured by scattering a 227 MeV /sup 40/Ca beam from a ^{6}Li target. Additionally, the cross section for the 3^- (3.74 MeV) state in /sup 40/Ca was measured at the same center-of-mass energy by scattering a 34 MeV ^{6}Li beam from /sup 40/Ca. The cross section for excitation of the 3^+, 2.18 MeV state in ^{6}Li is 3—5 times larger than that of the /sup 40/Ca 3^- state. The present data and previously measured elastic scattering data have been analyzed in the framework of both distorted-wave Born approximation and coupled channels calculations, using double folded real potentials, to determine the influence of the inelastic states on the elastic scattering cross section. We find that the elastic scattering is very sensitive to coupled channels effects arising from the 3^+ state in ^{6}Li.

4994 **Elastic scattering of 19.5 and 30 MeV negative pions from /sup 12/C.** Wright, D.H.; Blecher, M.; Boudrie, R.L.; Burman, R.L.; Leitch, M.J.; Ritchie, B.G.; Rothenberger, D.; Weinfeld, Z.; Alsolami, M.; Blanpied, G.; and others. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2139-2142(Nov 1987).

Elastic cross sections for the scattering of negative pions from /sup 12/C were measured at 19.5 and 30 MeV incident pion energy. At both energies the new cross sections show fair agreement with optical model predictions. At 30 MeV the new cross sections disagree at forward angles with previously measured values, while at 19.5 MeV the data represent the first report of /sup 12/C π^- scattering at this energy.

4995 **Accurate measurement of the /sup 10/B(n,p)/sup 10/Be cross section at thermal energies.** Lal, D.; Nishiizumi, K.; Reedy, R.C.; Suter, M.; Woelfli, W. (Scripps Institution of Oceanography, La Jolla, CA, USA; California Univ., San Diego, La Jolla, USA. Dept. of Chemistry; Los Alamos National Lab., NM, USA; Eidgenoessische Technische Hochschule, Zurich, Switzerland. Inst. fuer Mittelenergiephysik). *Nuclear Physics [Section] A;* **468**: No. 2, 189-192(29 Jun 1987).

Considering the varied geophysical applications of /sup 10/Be, we have made an accurate measurement of the thermal neutron cross section for the reaction /sup 10/B(n,p)/sup 10/Be. In the literature, only upper and lower limit values have been reported for this cross section. Using the accelerator mass-spectrometric technique for the detection of /sup 10/Be, we obtained a value of 6.8 +- 0.5 mb. This value is one order of magnitude lower than the cross section for the tritium channel in /sup 11/B compound nucleus.

4996 **Spin transfer in hyperon production.** Kruk, J. (T. W. Bonner Nuclear Laboratories, Rice University, P.O. Box 1892, Houston, TX 77251). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1200-1201(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The polarization transfer coefficient D/sub NN/ provides a sensitive test of present quark recombination models of hyperon production. In this paper we present preliminary results from a recent measurement of D/sub NN/ in the reaction p-arrow-rightBe → Lambda-arrow-rightX at the Brookhaven AGS using the newly available polarized proton beam at incident momenta of 13 and 18 GeV/c.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

4997 **(GANIL-P—87-07) Measurement of total reaction cross sections of exotic neutron rich nuclei.** Mittig, W.; Chouvel, J.M.; Wen Long, Z. (GANIL, 14 - Caen, France; Institute of Modern Physics, Lanzhou, China). (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753236/JAW.

Total reaction cross-sections of neutron rich nuclei from C to Mg in a thick Si-target have been measured using the detection of the associated γ-rays in a 4PI-geometry. This cross-section strongly increases with neutron excess, indicating an increase of as much as 15% of the reduced strong absorption radius with respect to stable nuclei.

4998 **Resonance structure of /sup 33/S+n from transmission measurements.** Coddens, G.P.; Salah, M.; Harvey, J.A.; Hill, N.W.; Larson, N.M. (Rijksuniversitair Centrum te Antwerpen, Belgium. Neutron Scattering Project; Minya Univ., Egypt; Oak Ridge National Lab., TN, USA). *Nuclear Physics [Section] A;* **469**: No. 3, 480-496(3 Aug 1987). Contract AC05-84OR21400.

The neutron total cross section for /sup 33/S has been determined for energies from 10 keV up to 2 MeV at the Oak Ridge Electron Linear Accelerator (ORELA) by a time-of-flight (TOF) transmission experiment. By combining these results with (n, α) data obtained at the Geel Electron Linear Accelerator (GELINA), resonance parameter (E/sub λ/, J/sup π/, and Γ/sub n/) have been determined up to 270 keV. Neutron strength functions for s- and p-wave resonances were derived. The p-wave strength function is much larger than for other nuclides in this mass region (/sup 30/Si, /sup 32/S, and /sup 34/S). This is discussed within the framework of the spherical optical model.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

4999 **(CEA-CONF—8974) Bound nucleon response functions measured with the /sup 40/Ca(e,e',p)/sup 39/K reaction and nuclear medium effects.** Magnon, A.; Reffay-Pikeroen, D.; Bernheim, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Mar 1987. 9p. (CEA-DPH-N-S—2424B; CONF-8703177—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750111/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

We have performed a separation of the longitudinal and transverse structure functions for the /sup 40/Ca(e,e'p)/sup 39/K reaction in the quasi-elastic region. Their ratio (L/T) is found reduced by about 30% from the Distorted Wave Impulse Approximation prediction. This result is compatible with the quenching of the Coulomb Sum-Rule observed in the inclusive ee' reaction. Since a possible swelling of the nucleon in nuclear matter has been advocated to explain this quenching, we have also measured the q-dependence of both structure functions to test this hypothesis. The results are not in favour of a large modification of the electromagnetic radius of the nucleon. From the transverse component, an upper limit of 5% can be derived for a possible increase of the radius.

5000 (INIS-mf—10996, pp 26-27) **Assessment of neutron induced deuteron- and tritium production cross sections for structural materials.** Uhl, M. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5001 (INIS-mf—10996, pp 28-29) **Calculation of recoil spectra.** Uhl, M. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5002 **(IPNO-DRE—86-19) Production, identification and structure of light nuclei far from stability.** Pougheon, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Oct 1986. 13p. (In French). (CONF-8610253—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750245/JAW.

From 4. Franco-Japanese colloquium on nuclear spectroscopy; Seillac, France (7 Oct 1986).

The aim of this paper will be to demonstrate that intermediate energy heavy-ions can be a powerful and in some regions an unique tool for studying cold matter with very unusual N/Z ratios. The ultimate goal of the study of exotic nuclei is probably not to produce all the isotopes predicted to be bound. The motivation of nuclear physics is to get a good description of nuclear matter through an unique elementary interaction by using self consistent theories. Studying nuclei far from stability may help to go in that direction. The most extreme N/Z ratios of nuclear ground-states are those at the border of nuclear stability that is near the proton and neutron drip lines. Mapping the drip lines in the light region Z < 30 was the goal of the experiments performed at GANIL on the LISE line. This work will be described in the second session. Besides this first aim, it appears that a most fruitful contribution from the study of exotic nuclei would come from the knoledge of basic nuclear parameters on long series of isotopes. These parameters are for instance the values of the binding energies as obtained from

mass measurements. Such measurements may also concern half lives, energy of the 2/sup +/ state and particle decay modes as β delayed neutron or proton emission or even more exotic decay modes as proton or two proton radioactivity.

5003 **(IPNO-DRE—86-25) Direct observation of new proton rich nuclei in the region 23 ≤Z≤29 using a 55 A.MeV /sup 58/Ni beam.** Pougheon, F.; Jacmart, J.C.; Quiniou, E. and others. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750666/JAW.

In this paper the first observation of twelve proton-rich nuclei is reported using 55 A. MeV /sup 58/Ni projectiles with a Ni target: the nuclei /sup 56/Cu, /sup 52/Co(Tz=-1), /sup 55/Cu, /sup 51/Co, /sup 47/Mn, /sup 43/V (Tz=-3/2), /sup 52/Ni, /sup 50/CO, /sup 48/Fe, /sup 46/Mn, /sup 44/Cr (Tz=-2) and /sup 51/Ni (Tz=-5/2) are observed. Magnetic separation and identification through time of flight and delta ExE measurements were used. The predicted proton drip-line has probably been reached for the odd elements.

5004 **Inelastic pion scattering to low-lying excited states of /sup 44/Ca.** Mordechai, S.; Harvey, C.; Cottingame, W.B.; Seidl, P.A.; Moore, C.F.; Bland, L.C.; Carchidi, M.; Fortune, H.T.; Seestrom-Morris, S.J.; Morris, C.L.; and others. (Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1950-1955(Nov 1987).

Differential cross sections were measured for pion inelastic scattering from /sup 44/Ca at T/sub π/ = 180 MeV. The low-lying collective states were analyzed using distorted-wave impulse-approximation calculations with transition densities obtained from electron and previous pion scattering. The cross sections for π^- and π^+ scattering to the low-lying collective states are nearly equal. Neutron and proton matrix elements have been extracted from simultaneous fits to π^- and π^+ data. The resulting values are in good agreement with data from hadronic and electromagnetic probes.

5005 **Magnetic moments of excited states in the stable chromium isotopes.** Pakou, A.; Tanczyn, R.; Turner, D.; Jan, W.; Kumbartzki, G.; Benczer-Koller, N.; Li, X.; Liu, H.; Zamick, a.L. (Department of Physics, Rutgers University, New Brunswick, New Jersey 08903). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2088-2094(Nov 1987).

The g factors of the first 2_1^+ states in /sup 50/Cr and /sup 54/Cr have been measured by the perturbed angular correlation/transient field technique. The results, $g(2^+_1, {}^{50}Cr) = +0.45(15)$ and $g(2^+_1, {}^{54}Cr) = +0.53(12)$, are compared to shell model calculations.

5006 **Search for muon-electron conversion with a time projection chamber.** Gotow, K. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 244-250(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

A Time Projection Chamber has been constructed at TRIUMF and is being used to search for a muon nonconserving process, $\mu^+(A,Z) \rightarrow e^+ + (A,Z)$, a coherent conversion of a negative muon in a muonic atom. (AIP)

6516 Nuclear Properties And Reactions, A=59-89, Experimental

5007 **(CEA-CONF—8942) Statistical fluctuations in deep inelastic collisions for the /sup 89/Y + /sup 19/F system.** Mermaz, C.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jan 1987. 15p. (CEA-DPH-N-S—2409; CONF-870153—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750082/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

This paper presents a more complete study of deep-inelastic collisions involving cross section fluctuations for an heavier system namely /sup 89/Y + /sup 19/ F and furthermore a comparison between nucleon reaction lifetimes extracted in one hand through reaction product angular distributions and in other hand through statistical fluctuations analysis of excitation functions. 17 refs, 11 figs, 1 tab.

5008 **(CRN-PN—86-05) Limit to incomplete fusion in the /sup 40/Ar + /sup 68/Zn reaction.** Coffin, J.P.; Fahli, A.; Rami, F. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750241/JAW.

The present work shows that IF occurs in the /sup 40/Ar + /sup 68/Zn reaction performed between 15 and 35 MeV/nucleon. It vanishes at an energy slightly higher than 35 MeV/nucleon either because of an excitation energy limit to — CN formation or because of an excessive loss of nucleons by the projectile. When compared to other results, the present data show that LMT depends on the energy and the mass of the projectile and on the asymmetry of the system. The numbers of prompt light fragments emitted by systems leading to equal LMT at similar V/sub rel/ are different and depend on the projectile and the relative velocity of the lighter partner (V/sub L/).

5009 **(DOE/ER/40330—1) Nuclear structure from radioactive decay: Annual progress report.** Wood, J.L. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 30 Sep 1987. Contract FG05-87ER40330. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001665/JAW.

The primary focus this year has been studies of intruder states and shape coexistence in the neutron-deficient Z ~ 82 region. Most notably, the existence and conditions for the occurrence of electric monopole (E0) transitions have been considerably clarified. This has been a topic of considerable confusion. On-line decay scheme spectroscopy of mass-separated isotopes at UNISOR (in a collaboration with LSU) has now completely resolved all points of disagreement. These studies are part of a larger program directed towards building a complete picture of shape coexistence. It is becoming evident that E0 transitions are a key signature to shape coexistence. Thus, their correct identification and location are crucial.

5010 **(EGG-M—26587) Review of nuclear data of relevance for the decay heat problem.** Reich, C.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 12p. (CONF-8709122—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001599/JAW.

From Specialists' meeting on data for decay heat predictions; Studsvik, Sweden (7 Sep 1987).

The decay data (T/sub 1/2/, Q/sub β/, <E/sub β/> and <E/sub γ/>) for fission-product nuclides are reviewed, with emphasis on those nuclides important for decay-heat calculations in the region from ~10 sec to ~10^3 sec. Problems involved in deducing <E/sub β/> and <E/sub γ/> values for these, and hence for even more neutron-rich, nuclides are illustrated by the example of ^{87}Br.

5011 **Shell-model studies of the N = 50 isotones in the ^{78}Ni doubly magic region.** Winger, J.A. Ames, IA; Iowa State Univ. (1987). 121p. University Microfilms Order No. 87-16,838.Contract W-7405-ENG-82.

Thesis (Ph. D.).

The study of excited states in the N = 50 isotones ^{82}Ge and ^{83}As following the β decay of the neutron-rich nuclei ^{83}Ga and ^{83}Ge is reported. This work was performed using the on-line isotope separator facility TRISTAN at Brookhaven National Laboratory. The ^{83}Ge half-life was measured to be 1.85 +/- 0.06 s. On the basis of γ singles and γ-γ coincidence measurements a total of 51 γ rays were placed in a level scheme for ^{83}As with 27 levels up to 4.84 MeV. The ^{83}Ga half-life was measured to be 0.62 +/- 0.02 s. On the basis of γ singles and γ-γ coincidence measurements, a total of 11 γ rays were placed in a level scheme for ^{83}Ge with 7 levels up to 3.26 MeV. These measurements also established the existence of delayed-neutron emission from ^{83}Ga by the observance of 6 γ

rays associated with the depopulation of levels in ^{81}Ge. An angular correlation measurement was performed for levels in ^{82}Ge to establish J/sup π/ values with only tentative results. The level structure for the N = 50 isotones ^{82}Ge, ^{83}As, ^{84}Se, ^{85}Br, and ^{86}Kr are compared with the results of a large-space shell-model calculation assuming an inert ^{78}Ni core. The results of this comparison do not establish the validity of the inert ^{78}Ni core.

5012 **/sup 76/Ge $\beta\beta$-decay experiments and their analyses, an update.** Avignone, F.T.; Miley, H.; Brodzinski, R.L.; Reeves, J.H. (University of South Carolina, Columbia, SC 29208). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1017-1024(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The status, progress and projections of /sup 76/Ge $\beta\beta$-decay experiments is reviewed. Sources of radioactive background, progress in their elimination and projections of future background levels are discussed. Existing data from the lowest background experiments are combined to extract a "world limit" on the Majorana mass of the electron neutrino, <M/sub ν/>approx. <2.2 eV.

5013 **A new limit on the neutrinoless double beta decay lifetime.** Caldwell, D.O.; Eisberg, R.M.; Grumm, D.M.; Hale, D.L.; Witherell, M.S.; Goulding, F.S.; Landis, D.A.; Madden, N.W.; Malone, D.F.; Pehl, R.H. (Physics Dept., Univ. of California, Santa Barbara, CA 93106). pp 249-251 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A lower limit of 5 x 10/sup 22/y (68% CL) has been obtained for the half life of the neutrinoless double beta decay of /sup 76/Ge. This process would require lepton number non-conservation and that the electron neutrino have a mass and/or the weak interaction have right-handed currents. For this first data from a multidetector system, two Ge detectors were used for 1618 h inside a NaI active shield, giving a background at the expected 2.041-MeV peak considerably lower than in any other above-ground experiment.

5014 **Results from a ^{76}Ge double beta decay experiment.** Forster, A.; Kwon, H.; Markey, J.K.; Boehm, F.; Henrikson, H.E. (California Institute of Technology, Pasadena, CA 91125). *AIP (American Institute of Physics) Conference Proceedings;* **114**: No. 1, 199-205(May 1984). (CONF-8309163—).

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

Results from a 76-Ge double beta decay experiment are presented. The experimental set-up and results of background studies are presented. (AIP)

6517 Nuclear Properties And Reactions, A=90-149, Experimental

5015 **(CEA-CONF—8972) Samarium isotopes studied by electron scattering.** Goutte, D.; Meot, V.; Phan, X.H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Mar 1987. 9p. (CEA-DPH-N-S—2413; CONF-8703177—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750092/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Charge and transition charge densities for the ground state rotational band (0/sup +/, 2/sup +/, 4/sup +/ and 6/sup +/) of /sup 152/Sm and transition charge densities for the first excited 2/sup +/ state in five samarium isotopes (144, 148, 150, 152 and 154) have been extracted from electron scattering cross sections. These densities are compared to theoretical approaches such as the Interacting Boson Model or microscopic Hartree-Fock-Bogoliubov calculations.

5016 **(CRN-PN—86-28) Large angular momentum shape transitions in /sup 144/Gd and /sup 152/Dy.** Nourreddine, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Sep 1986. 233p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750259/JAW.

In this work dealing principally with superdeformed states of nuclear matter, it has been shown that nuclei like /sup 144/ /sub 64/Gd/sub 80/ and /sup 152/ /sub 66/Dy/sub /8/sub 6/ situated near the closed shells Z = 64 and N = 82 exhibit low spin (I < 40 h/2π) single particle states as well as high spin collective behavior corresponding to triaxial shapes and, in some cases, to superdeformed shapes. Among other things, the present experiments have brought theoretical attention to the effects of nuclear temperature and have demonstrated the important role played by quasi-symmetrical fusion-evaporation reactions in structure and behavior studies of nuclei at very high spin, and in particular, in the population of superdeformed states.

5017 **(GSI—87-37-Prepr.) Periodic multi-proton transfer strength in collisions between heavy nuclei.** Wagner, W.; Mayer, W.; Beier, G.; Friese, J.; Henning, W.; Kienle, P.; Koerner, H.J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Jun 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750174/JAW.

A periodic variation of the multi-proton transfer probability as a function of the nuclear charges of the residual nuclei has been observed in collisions of /sup 238/U with /sup 110/Pd and /sup 124/Sn at bombarding energies close to the Coulomb barrier. After the N=82 closed neutron shell of the light reaction partner is filled through multi-neutron transfer and an energy dissipation of about 100 MeV, transfer of pairs of protons is observed with modulated transfer strength. The proton multi-pair transfer dissipates no further energy.

5018 (INDC(CCP)—275/L, pp 5-15) **Experimental and evaluated data on cross-sections for (n,n'), (n,2n) and (n,3n) reactions on /sup 93/Nb.** Kotel'nikov, G.B.; Lovchikov, G.N.; Sal'nikov, O.A.; Simakov, S.P. Jun 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700019/JAW.

Original report in Russian was distributed as INDC(CCP)-244/G.

In Translation of selected papers published in Nuclear Constants 1, 1985.

Compilation and analysis of the experimental data on cross-sections for the (n,n'), (n,2n) and (n,3n) reactions on /sup 93/Nb have been carried out. Experimental results are compared with evaluated data from the INDL/V, ENDF/B-IV and ENDL libraries. It was concluded that experimental results are described most accurately by the INDL/V library data. Exceptions to this are cross-sections for the (n,2n) reaction and the high-energy part of neutron emission spectra, which, in the light of the most recent experiments, must be re-evaluated. 42 refs, 5 figs. Translated from Russian.

5019 (INIS-mf—10996, pp 13-18) **Measurement of the activation cross section for the dosimetry reaction /sup 93/NB(N,N')/sup 93M/NB at E/sub n/ — 2.9 MeV.** Wagner, M.; Winkler, G.; Vonach, H.; Petoe, G. (Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5020 (INIS-mf—10996, pp 19-20) **Measurement of the cross section of the reaction /sup 93/NB(N,N')/sup 93M/NB at E/sub N/ — 7.9 MeV by activation.** Wagner, M.; Winkler, G.; Vonach, H.; Liskien, H. (Van de Graff Lab., Geel, Belgium. Central Bureau for Nuclear Measurements). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5021 **(INS—613) Precise measurement of Ag KLL Auger-spectrum.** Kawakami, H.; Nisimura, K.; Ohshima, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700056/JAW.

An accurate measurement of the KLL Auger spectrum of Ag in the decay of /sup 109/Cd is performed by the use of a high-resolution, high-efficiency iron-free β-spectrometer system. As a source of Auger electrons, /sup 109/Cd is prepared in a form of arachidic (C/sub 20/H/sub 40/O/sub 2/) Cd-salt with a thickness of two molecular layers by means of the Langmuir-Blodgett method. A /sup 169/Yb source is used to calibrate the absolute energy of the spectrometer using the M conversion lines of the 20.744 keV transition in /sup 169/Tm. These two sources are set in the position of the spectrometer interchangeably. The β-rays analyzed by the spectrometer is detected by a 40-cell proportional counter placed on the focal plane. A focusing electric potential is applied over the source plate, and the spectrum is scanned electrostatically by changing the acceleration voltage also applied on the source, keeping the magnetic field strength constant. Auger spectra are measured by a scanning step of 2.4 eV with 18 steps in total. The energy dispersion of individual detector cells is measured by shifting the Auger spectrum with the acceleration voltage. As a result, all the nine Auger lines are clearly resolved. The resultant accuracy for the energies and intensities improved those of the previous data by 1 - 2 orders of magnitude. The result indicates a good agreement with the calculations by Larkins and by Chen et al. But some discrepancies for low-intensity lines suggest a necessity of finer theoretical investigation on the mechanism of the KLL Auger transition. (Nogami, K.).

5022 **(LYCEN—8659) New exotic rare-earth nuclei studied with a He jet coupled to a mass separator on-line with Sara.** Beraud, R.; Gizon, A.; Genevey, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Sep 1986. 6p. (CONF-8609159—10). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750256/JAW.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

Fusion-evaporation reactions with /sup 32/S, /sup 35/Cl and /sup 36/Ar beams on /sup 92/Mo, /sup 106/Cd and /sup 112/Sn targets have been used to search for new activities. The reaction products transported via a He-Jet system coupled to a mass-separator for mass identification have been studied by γ-ray and X-ray spectroscopy techniques. Decay schemes of at least seven new isotopes have been derived. Data are presented through systematics and compared to recent theoretical calculations.

5023 **/sup 112/Cd from /sup 110/Cd(t,p).** Medsker, L.R.; Fortune, H.T.; Zumbro, J.D.; Browne, C.P.; Mateja, J.F. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1785-1791(Nov 1987).

The level structure of /sup 112/Cd has been investigated with the reaction /sup 110/Cd(t,p), at E/sub t/ = 15.0 MeV. Twenty-nine angular distributions have been measured and compared to predictions of distorted-wave Born-approximation calculations to extract L, and hence J/sup π/, values.

5024 **Search for double beta decay in /sup 100/Mo and /sup 92/Mo.** Elliott, S.R.; Hahn, A.A.; Moe, M.K. (Physics Department, University of California, Irvine, California 92717). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2129-2131(Nov 1987).

A natural molybdenum source was used in a time projection chamber to look for five modes of $\beta\beta$. We place half-life limits of 6.8 x 10/sup 17/ yr on $\beta\beta(2\nu)$, 1.3 x 10/sup 19/ yr on $\beta\beta(0\nu)$, and 7.5 x 10/sup 18/ yr on $\beta\beta(0\nu,B)$ for /sup 100/Mo, and limits of 2.3 x 10/sup 17/ yr on β^+,EC(2ν) and 2.7 x 10/sup 18/ yr on β^+,EC(0ν) for /sup 92/Mo.

5025 **E0 decays of 0^+ states in /sup 146/Gd: Search for two-phonon octupole excitations.** Yates, S.W.; Mann, L.G.; Henry, E.A.; Decman, D.J.; Meyer, R.A.; Estep, R.J.; Julin, R.; Passoja, A.; Kantele, J.; Trzaska, W.; and others. (Department of Chemistry, University of Kentucky, Lexington, Kentucky 40506). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2143-2145(Nov 1987).

Conversion-electron measurements following the /sup 144/Sm(α,2n) and /sup 144/Sm(^{3}He,n) reactions reveal high-energy E0 transitions at 3020, 3485, and 3639 keV. The lowest of these deexcites the known two-neutron pairing vibrational state in /sup 146/Gd. It is not clear whether either of the others can be associated with the 0^+ member of the 3^- x 3^- two-phonon octupole multiplet.

5026 **Nuclear Data Sheets for A = 136.** Burrows, T.W. (National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973). *Nuclear Data Sheets;* **52**: No. 2, 273-363(Oct 1987). Contract AC02-76CH00016.

The 1979 evaluation of A = 136 (79Pe02) has been revised using experimental decay and reaction data received by August 5, 1987. Copyright 1987 Academic Press, Inc.

5027 **Systematics of quasi-elastic neutron transfer cross sections for heavy-ion induced reactions.** Berg, A.M. van den; Rehm, K.E.; Kovar, D.G.; Kutschera, W.; Stephans, G.S.F. (Argonne National Lab., IL, USA). *Physics Letters [Section] B;* **194**: No. 3, 334-337(13 Aug 1987). Contract W-31-109-ENG-38.

Quasi-elastic neutron transfer reactions on samarium isotopes using a /sup 58/Ni beam at a center of mass energy of 245 MeV have been studied. Angle-integrated cross sections for one-neutron pickup reactions show an increase as a function of the target mass number A. Together with data from other systems covering a large range in mass and Q-value it is observed that the quasi-elastic one-neutron-transfer cross sections follow a simple systematic behaviour.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

5028 **(GANIL-P—87-14) Spectator recoil and nucleon emission spectra in intermediate energy nuclear collisions.** Bandopadhyay, D.; Samaddar, S.K.; Krishan, K.; De, J.N. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750458/JAW.

The preequilibrium nucleon spectra for intermediate energy heavy ion collisions are calculated in a hot-zone model based on the concept of equal participation. The recoil spectra of heavy spectators are also calculated. The results are in good agreement with the experimental data.

5029 **Magnetic properties of the /sup 176/Lu ground-state band.** Deleze, M.; Bruder, A.; Drissi, S.; Kern, J.; Struble, G.L. (Physics Department, University of Fribourg, CH-1700 Fribourg, Switzerland). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1826-1829(Nov 1987).

The lowest members of the /sup 176/Lu ground-state band have been Coulomb excited by /sup 16/O ions. From the observed branching ratios and angular distribution coefficients, we obtain G/sup K//sup K//Q_0 = 0.18(1). Combining this result with the known magnetic moment of the ground state, we derive g/sub R/ = 0.288(9) and (g/sub Ω//sub =/+g/sub Ω//sub =/) = 0.953(3). These values are in substantial agreement with semiempirical model predictions.

5030 **Search for entrance-channel effects in the production of superdeformed nuclei.** Macchiavelli, A.O.; Deleplanque, M.A.; Diamond, R.M.; McDonald, R.J.; Stephens, F.S.; Draper, J.E. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2177-2179(Nov 1987).

In order to test whether entrance channel effects influence the production of superdeformed nuclei, the yields of the discrete superdeformed band in /sup 152/Dy are compared for three projectile-target combinations. No evidence for entrance channel effects is found. Rather, the population of this band seems to be determined by the excitation energy and maximum angular momentum brought in by each reaction.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

5031 **(CEA-CONF—8968) One proton and one neutron transfer reactions induced by /sup 16/O on /sup 208/Pb at 50 MeV/A.** Berthier, B.; Barrette, J.; Gillibert, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Jan 1987. 10p. (CEA-DPH-N-S—2433; CONF-870153—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750100/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

Single nucleon transfer reactions induced by heavy ion at a very high incident energy (50 MeV/A) is reported here. Reliable spectroscopic informations in residual nuclei could be obtained since the reaction mechanism leading to many low lying states is typically direct and can be properly described by usual DWBA calculations.

5032 **(CEA-CONF—8970) Fragmentation at relativistic energies.** Lucas, R.; Berthier, B.; Boisgard, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Mar 1987. 4p. (CEA-DPH-N-S—2422; CONF-8703177—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753239/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Inclusive nuclear fragments of atomic number 2 $\leqq$ Z/sub f/ $\leqq$ 13 produced in the 60 and 226 GeV/u /sup 16/O + /sup 197/Au reaction have been detected at CERN. These products, which are coming from the target spectators, have an atomic number distribution which obeys a Z/sub f//sup -tau/ power law, where tau $\simeq$ 2.3.

5033 **(GANIL-P—86-14) Reaction mechanisms with intermediate-energy heavy ions: the surprises of semi-exclusive studies.** Peter, J. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 13p. NTIS (US Sales Only), PC A02. Order Number DE87752589/JAW.

Several semi-exclusive experiments have recently been made: a large solid angle light particle multidetector at forward angles has been used in coincidence with other reaction products. The conclusions are somewhat different from expectations based on inclusive results. Two examples are given. For Ar projectiles at 35 MeV/u, transfer reactions remain the most important part of quasi-elastic projectile-like fragments; when projectile fragmentation occurs, it is most often asymetric multi-fragmentation. At 60 MeV/u, in two particles correlations at small relative momenta, the correlation peak is strongly enhanced in low multiplicity events in the multidetector, and reduced for high multiplicity events; this is related to the lifetime of the source, as well as to its spatial extension.

5034 **(GSI—86-56-Prepr.) On the production of superheavy elements and the limitations to go beyond.** Armbruster, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Dec 1986. 36p. (CONF-861061—4-Prepr.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750163/JAW.

From International School of Heavy Ion Physics course on the response of nuclei under extreme conditions; Erice, Italy (12 Oct 1986).

The author reviews the experimental results on the production of superheavy elements by heavy ion fusion reactions at GSI. In this connection he discusses theoretical limits on the cross sections in such reactions. (HSI).

5035 **(GSI—87-36-Prepr.) Correlated fragment production in /sup 18/O induced reactions at E/A = 84 MeV.** Trockel, R.; Lynen, U.; Trautmann, W.; Hildenbrand, K.D.; Mueller, W.F.J.; Rabe, H.F.; Sann, H.; Stelzer, H.; Wada, R.; Pochodzalla, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik; Muenster Univ. (Germany, F.R.). Inst. fuer Kernphysik; Heidelberg Univ. (Germany, F.R.)). Jun 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750188/JAW.

Correlations between intermediate-mass fragments (IMF) and heavy fragments were measured for /sup 18/O induced reactions on /sup nat/Ag and /sup 197/Au at E/A = 84 MeV. Both, correlation functions of two fission products and of a heavy recoil in coincidence with an IMF show maxima at relative velocities v/sub rel/ $\simeq$ 2-3 cm/ns and a depletion at v/sub rel/ $\leqq$ 1 cm/ns, thus confirming the binary character of these processes. Coincidences between two IMF's show an anticorrelation at low relative velocities reflecting the proximity of the two IMF's at the point of creation.

5036 **α-decay reduced width of /sup 194/Pb and low-spin levels in /sup 194/Tl populated in /sup 194/Pb β decay.** Ellis-Akovali, Y.A.; Toth, K.S.; Carter, H.K.; Bingham, C.R.; Girit, I.C.; Kortelahti, M.O. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1529-1539(Oct 1987). Contract AC05-84OR21400.

The α decay of /sup 194/Pb [E/sub α/ = 4.64 +- 0.02 MeV, α branch = (7.3 +- 2.9) x 10/sup -6/%] was identified for the first time, and a comprehensive decay scheme was constructed for the isotope's β-decay branch. This scheme consists of 29 excited levels built on the 2^- /sup 194/Tl ground state and incorporates 91 γ-ray transitions. Based on the decays of several strong transitions, the half-life of /sup 194/Pb was measured to be 12.0 +- 0.5 min. The /sup 194/Pb α reduced width, calculated with these data, is less than those of Pb, Hg, and Pt nuclei with A$\leqq$192, indicating that the Z = 82 gap is perhaps being restored for N$\geqq$112.

5037 **Nuclear Data Sheets for A = 200.** Schmorak, M.R. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Nuclear Data Sheets;* **51**: No. 4, 689-764(Aug 1987). Contract AC05-84OR21400.

Experimental data pertaining to nuclei with A = 200 are compiled and evaluated. copyright 1987 Academic Press, Inc.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

5038 **(CENBG—8611) Study of the mass, nuclear charge and kinetic energy distribution of the fission fragments produced in the reaction /sup 237/ Np (/sup 2n/ th, f).** Martinez, G. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1986. 159p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750238/JAW.

In this work, we report fission fragment mass, energy and charge distributions measured for the fissioning nucleus: /sup 239/Np /sup 146/, This odd Z nucleus is formed after double thermal neutron capture on to the /sup 237/ Np /sup 144/ target nucleus. These measurements were performed at the I.L.L. recoil mass spectrometer "Lohengrin" in Grenoble. The fission fragments were registered by an ionisation chamber placed at the focal plane of the spectrometer. The obtained distributions are compared to the /sup 240/ Pu /sup 146/ fragment mass, energy and charge distributions. They are discussed within the Wilkins' scission-point model. Cold fission has been studied while selecting fragmentations with final kinetic energies close to the maximum energy released in the reaction. These cold fission events are discussed according to a calculation based on the Wilkins' scission-point model extrapolated to the cold fragmentation case. 51 refs.

5039 **(GSI—87-43-Prepr.) New nuclides: Neptunium-243 and neptunium-244.** Moody, K.J.; Bruechle, W.; Bruegger, M.; Gaeggeler, H.; Haefner, B.; Schaedel, M.; Suemmerer, K.; Tetzlaff, H.; Kaffrell, N.; Kratz, J.V. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie; Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Nuclear Chemistry; Los Alamos National Lab., NM (USA)). Aug 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750447/JAW.

We have observed gamma-rays following the β/sup -/-decay of /sup 243/Np and /sup 244/Np after chemical isolation of neptunium isotopes from the products of the reaction of 835 MeV /sup 136/Xe with /sup 244/Pu. The ground-state of 1.85-min /sup 243/Np has J=5/2. The decay of 2.29-min /sup 244/Np (probable J/sup π/=7/sup -/) populates high-spin members of the ground state rotational band in /sup 244/Pu.

5040 **(INDC(CCP)—275/L) Translation of selected papers published in Nuclear Constants 1, 1985.** (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jun 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700019/JAW.

Original report in Russian was distributed as INDC(CCP)-244/G.

The report contains the following 4 papers: Experimental and Evaluated Data on Cross-Sections for (n,n'), (n,2n) and (n,3n) Reactions on 93 Nb; Transmission Function Measurements, Evaluation of Mean Resonance Parameters and Group Constants for /sup 235/U in the Unresolved Resonance Region; An Evaluation of the Spontaneous Fission Prompt Neutron Spectrum of /sup 252/Cf; Angular and Energy Distributions of /sup 252/Cf Spontaneous Fission Neutrons. Each of these papers has a separate abstract.

5041 (INDC(CCP)—275/L, pp 27-52) **Evaluation of the spontaneous fission prompt neutron spectrum of /sup 252/Cf.** Bojkov, G.S.; Yurevich, V.I. Jun 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700019/JAW.

Original report in Russian was distributed as INDC(CCP)-244/G.

In Translation of selected papers published in Nuclear Constants 1, 1985.

An evaluation of the spontaneous fission prompt neutron spectrum of /sup 252/Cf from 1 keV to 20 MeV is described. Variance-covariance matrices for a number of recent experimental data sets were constructed and used to evaluate the neutron spectrum following a Bayesian procedure. The evaluated spectrum is compared with various experimental and theoretical representations. 61 refs, 6 figs, 9 tabs. Translated from Russian.

5042 (INDC(CCP)—275/L, pp 53-66) **Angular and energy distributions of /sup 252/Cf spontaneous fission neutrons.** Seregina, E.A.; D'yachenko, P.P. Jun 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700019/JAW.

Original report in Russian was distributed as INDC(CCP)-244/G.

In Translation of selected papers published in Nuclear Constants 1, 1985.

Methods are described for measuring the energy distributions of /sup 252/Cf spontaneous fission neutrons using a single-crystal recoil proton spectrometer, and for reconstructing neutron spectra from the instrumentally-derived distributions with the inclusion of a realistic spectrometer response function. The energy spectra obtained are shown for ten angles between the direction of motion of the neutrons and the axis of emergence of the fragments (3 deg., 10 deg., 20 deg., ..., 90 deg.) within the energy range 0.7-8.1 MeV. Comparison of the results obtained with data from other authors showed that the picture of angular and energy distributions of /sup 252/Cf spontaneous fission neutrons is somewhat different from that previously established. This applies particularly to angles between the fragment emergence axis and the direction of the neutrons which are close to 0 deg. and 90 deg. 11 refs, 6 figs. Translated from Russian.

5043 (INIS-mf—10996, pp 20-24) **/sup 252/Cf fission neutron spectrum above 15 MeV.** Chalupka, A.; Malek, L.; Tagesen, S.; Boettger, R. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5044 (INIS-mf—10996, pp 24-25) **Radioactive decay of /sup 223/Ra by /sup 14/C emission.** Weselka, D.; Chalupka, A.; Malek, L.; Hille, P.; Vonach, H. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5045 **(IPNO-DRE—86-18) Spontaneous emission of fragments from nuclei.** Hourani, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Sep 1986. 17p. (CONF-8609219—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750244/JAW.

From Brasov international summer school: symmetrics and semiclassical features of nuclear dynamics; Poiana Brasov, Romania (1 Sep 1986).

Several cases of spontaneous emission of fragments from heavy nuclides have been experimentally observed up to now. So, spontaneous decays intermediate between α-decay and fission, previously predicted, are definitively established. Three experimental techniques have been involved so far giving a striking agreement in branching ratio measurements. The first technique of a ΔE x E solid state detector telescope placed in a direct view of the source as in the discovery of the phenomenon seems to have no role left to play. The second technique based on a magnetic selection of the fragments from the very high flux of α-particles is much more powerful in fragment/α branching ratio measurements and present a specific interest in its capability of measuring with precision various characteristics of the fragments, e.g. the energy, Z, A... It is however, the third technique using track solid detectors which seems to yield the smallest fragment/α branching ratios, and consequently to have in the future the most important role to play.

5046 **(LA—11078-MS) Preliminary measurement of the ^{235}U(n,f) cross section up to 750 MeV.** Rapaport, J.; Ullmann, J.; Nelson, R.O.; Seestrom-Morris, S.; Wender, S.A.; Haight, R.C. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001945/JAW.

The recently commissioned high energy white neutron source was used to measure the neutron fission cross section of ^{235}U in the energy range from 0.6 to 750 MeV. The shape of the cross section from 0.6 to 20 MeV agrees well with previous reported data. Absolute values for the ^{235}U(n,f) cross section from 20 MeV to 750 MeV were obtained by normalizing the measured shape of the cross section to data in the 10 to 20 MeV range. 12 refs., 9 figs.

5047 **Excitation functions for production of heavy actinides from interactions of /sup 16/O with /sup 249/Cf.** Chasteler, R.M.; Henderson, R.A.; Lee, D.; Gregorich, K.E.; Nurmia, M.J.; Welch, R.B.; Hoffman, D.C. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1820-1825(Nov 1987). Contract AC03-76SF00098.

Excitation functions have been measured for the production of isotopes of Bk through Fm in bombardments of /sup 249/Cf with 90- to 150-MeV /sup 16/O ions. A comparison of the maxima of the mass-yield curves measured in this experiment with those for the reactions of /sup 18/O ions with /sup 249/Cf shows different shifts from those that have been measured for reactions of the /sup 16,18/O and /sup 20,22/Ne ion pairs with /sup 248/Cm. However, the shifts appear similar to those recently measured for reactions of these ion pairs with /sup 254/Es.

5048 **Thermal-neutron fission cross section of 26.1-min / sup 235/U/sup m/.** Talbert W.L. Jr.; Starner, J.W.; Estep, R.J.; Balestrini, S.J.; Attrep M. Jr.; Efurd, D.W.; Roensch, F.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 1896-1899(Nov 1987).

The thermal-neutron fission cross section of /sup 235/U/sup m/ has been measured relative to the ground-state cross section. A rapid radiochemical separation procedure was developed to provide sizeable (10/sup 10/ to 10/sup 11/ atom) samples that were reasonably free of the parent /sup 239/Pu. From a series of eight measurements, the value of 1.42 +- 0.04 was obtained for the ratio σ/sub m//σ/sub g/.

5049 **Search for sharp lines in e^+-e^- coincidences from positrons on Th.** Wang, T.F.; Ahmad, I.; Freedman, S.J.; Janssens, R.V.F.; Schiffer, J.P. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 5, 2136-2138(Nov 1987). Contract W-31-109-ENG-38.

Two mini-orange spectrometers were used to view e^+-e^- pairs from a positron source and a Th scatterer from opposite directions, 180° apart. No statistically significant evidence for peaks previously reported was found in the coincidence spectra.

5050 **180°-correlated equal-energy photons from 5.9-MeV/nucleon U + Th collisions.** Danzmann, K.; Meyerhof, W.E.; Montenegro, E.C.; Xu, X.; Dillard, E.; Huelskotter, H.P.; Stephens, F.S.; Diamond, R.M.; Deleplanque, M.A.; Macchiavelli, A.O. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review Letters;* **59**: No. 17, 1885-1888(26 Oct 1987).

We have found a narrow line (intrinsic width $\leq$2.5 keV) at 1062 +- 1 keV in the summed-energy 180°-c.m.-correlated two-photon spectrum from 5.95-MeV/nucleon U+Th collisions. Including possible systematic uncertainties, the production cross section is found to be 50 +- 25 μb, averaged over the 1-mg/cm^2 Th target thickness. This line may belong to the decay of a neutral system which also produces correlated electron-positron pairs found by others in the same reaction.

5051 **Nuclear Data Sheets for A = 222.** Ellis-Akovali, Y.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6371). *Nuclear Data Sheets;* **51**: No. 4, 765-782(Aug 1987). Contract AC05-84OR21400.

The available nuclear structure information for all nuclei with mass number A = 222 is presented. Various decay and reaction data are evaluated and compared. Adopted data, levels, spin and parities are given. Some recently measured T/sub 1/2/ for A = 226 parents: T/sub 1/2/(/sup 226/Rn) = 7.4 min 1 (86Bo35). Other measurement 6.0 min 5 (69Ha03). T/sub 1/2/(/sup 226/Fr) = 49 s 1 from 48 s 1 (75Ra03) and 49 s 1 (86Bo35). copyright 1987 Academic Press, Inc.

5052 **Anomalous positron production.** Greenberg, J.S. (Yale University, A. W. Wright Nuclear Structure Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 112-114(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief review of experimental data which yield evidence for electron—positron pair production in heavy ion reactions is given. Reaction mechanisms for the electron—positron production are discussed.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 4582, 4741, 4804, 4807, 4855, 4865, 4866, 4868, 4870, 4873, 4873, 4883, 4886, 4909, 4932, 4939, 4957, 4966, 4975, 4989, 5034

5053 (ANL—85-22, pp 132-133) **Role of virtual pairs in relativistic nucleon-nucleus interactions.** Keister, B.D. (Carnegie Mellon Univ., Pittsburgh, PA). Sep 1985. NTIS, PC A18/MF A01. Order Number DE86002650/JAW.

In Physics Division annual review, 1 April 1984-31 March 1985.

The striking success of Dirac phenomenology in fitting the polarization observables in proton-nucleus scattering raises several questions about its deeper significance. The Dirac equation is rooted in a quantum field theory which treats the proton as a point particle and requires antiparticles as a condition of Lorentz invariance. The successful feature, a strong spin-orbit interaction not present in a corresponding nonrelativistic treatment, survives for nonrelativistic velocities of the incoming proton and can clearly be traced to the antiparticle degrees of freedom. Can this prominence of virtual pairs at low energy be reconciled with the fact that nucleons are extended objects composed of quarks? Introduction into the field theory of nucleon form factors, which mock up the size of the nucleon, strongly suppresses the virtual pair effects which are essential for its success. One therefore has the choice of accepting the Dirac treatment of the basis of its formal simplicity or rejecting it on the basis of its physical implausibility. The latter choice requires an alternative explanation of the data.

5054 (ANL—85-22, pp 136-139) **Study of pion absorption of nuclei.** Lee, T.S.H.; Ohta, K.; Thies, M. (Univ. of Tokyo, Japan). Sep 1985. NTIS, PC A18/MF A01. Order Number DE86002650/JAW.

In Physics Division annual review, 1 April 1984-31 March 1985.

The purpose of this work is to develop a microscopic description of pion absorption by finite nuclei. Our first step is to examine carefully the extent to which the extensive data of inclusive (π,p) reactions can be described by the simplest two-body processes. The basic absorption process is described by a πNN-NΔ-NN transition matrix, derived from the model Hamiltonian constructed by Betz and Less in an earlier study of NN and πd scattering. The two-nucleon mechanism into complex nuclei, using the impulse approximation was then embedded. The main features of (π^+,p) reactions of ^{3}He, ^{4}He, and ^{12}C are predicted correctly, when large pion distortion effects are taken into account by using the isobar-hole model. However, the weaker (π^-,p) cross section is found to be underestimated by the theory by a very larger factor.

5055 **(BNL—40316) TRISTAN research on neutron rich nuclei: Magnetic moments and nuclear structure.** Wolf, A.; Casten, R.F.; Gill, R.L.; Brenner, D.S.; Mach, H.; Hill, J.C.; Wohn, F.K.; Winger, J.A. (Brookhaven National Lab., Upton, NY (USA); Clark Univ., Worcester, MA (USA); Ames Lab., IA (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-870970—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002122/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The TRISTAN research program is briefly outlined. The discussion then turns to the measurements of magnetic moments of excited states in neutron-rich fission product nuclei using the perturbed angular correlation method. The results for 2_1^+ states are analyzed in light of the systematics of magnetic moments in the A = 70-200 region, and relation to collective nuclear models. 28 refs.

5056 **(CEA-CONF—8910) Electron scattering and few-nucleon systems.** Frois, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Oct 1986. 21p. (CONF-8610239—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750078/JAW.

From Electron scattering in nuclear and particle science: in commemoration of the 35th anniversary of the Lyman-Hanson-Scott experiment; Urbana, IL, USA (23 Oct 1986).

In these lectures, is discussed a selection of recent electron scattering data which illustrate some of the recent developments of this field. The last five years have seen the emergence of a new generation of electron scattering experiments. These data have clearly shown the limits of the traditional description of nuclear physics.

5057 **(CEA-CONF—8983) Multifragmentation of nuclei.** Ngo, C.; Desbois, R.; Nemeth, J.; Barranco, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Mar 1987. 8p. (CEA-DPH-N-S—2438; CONF-8703153—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752772/JAW.

From International workshop on semi-classical and phase-space approaches to the dynamics of the nucleus; Aussois, France (16 Mar 1987).

We review a model based on irrotational hydrodynamics and percolation which has been applied to the study of hot and excited nucleus disassembly. The different conditions under which an excited nucleus breaks up in several pieces (multifragmentation) are given.

5058 **(CSIR-TWISK-TR—499) Intermediate energy deuteron-nucleus scattering and the properties of the nucleon-nucleus potential.** Greben, J.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). 1986. 14p. CSIR Publications Distribution Division, P.O. Box 395, Pretoria, 0001, South Africa.

Deuteron scattering from /sup 16/O at 400 MeV is analyzed in terms of the folding model. It is shown that a vast range of local nucleon-nucleus potentials is unable to give a proper description of A/sub yy/ at relatively low momentum transfers. We attribute this discrepancy to inadequacies in the off-shell properties of the nucleon-nucleus potential.

5059 **(DOE/ER/40150—36) Investigation of multiple particle final states at CEBAF.** Mecking, B.A. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 13p. (CEBAF-PR—87-026). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001719/JAW.

The physics motivation for the investigation of multiple particle reactions at the CEBAF 4 GeV electron accelerator is examined. The corresponding requirements for the accelerator and the detector are outlined. 10 refs., 4 figs.

5060 **(FEI—1802) KOP program for calculating cross sections of neutron and charged particle interactions with atomic nuclei using the optical model.** Grudzevich, O.D.; Zelenetskij, A.V.; Pashchenko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700331/JAW.

The last version of the KOP program for calculating cross sections of neutron and charged particle interaction with atomic nuclei within the scope of the optical model is described. The structure and program organization, library of total parameters of the optical potential, program identificators and peculiarities of its operation, input of source data and output of calculational results for printing are described in detail. The KOP program is described in FORTRAN- and adapted for EC-1033 computer. 9 refs.; 1 tab.

5061 **(GANIL-T—86-01) Semi-classical approach of heavy ion physics at intermediate energies.** Vinet, L. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 12 Sep 1986. 149p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753226/JAW.

The study of heavy ion collisions at intermediate energies (10 to 100 MeV/A), can be undertaken by a semi-classical approach: the nuclear Vlasov equation. It is possible to decompose the one body distribution function over a suitable coherent state basis for dynamical studies. This method is applied for colliding slabs, and the results are compared with those of TDHF. With imposed spherical symmetry, the isoscalar monopole resonance, evaporation, formation of bubble nuclei and total evaporation, are obtained. The extension to three dimensions and to the Landau-Vlasov equation through the residual interaction included in the Uehling-Uhlenbeck collision term, permits a general study of the dynamical instability of highly excited nuclei. The application to heavy ion collisions gives a description of both the main mechanisms of reaction, and the ineffective fusion for the system /sup 40/Ar (35 MeV/A) + /sup 27/Al. Alpha particle multiplicities in correlation with evaporated residues in the experience /sup 40/Ar (27 MeV/A) + /sup 27/Al, have been extracted. From theoretical results, different scenari are proposed (entrance channel limitation and exit channel disintegration), in order to explain the disappearance of the fusion component observed for this system at energies above 32 MeV/A.

5062 **(GSI—87-35-Prepr.) Phenomenon of narrow positron line emission in very heavy ion collisions.** Bokemeyer, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1987. 16p. (CONF-870164—6-Prepr.; CONF-870390—12-Prepr.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750170/JAW.

From 7. Moriond workshop: searches for new and exotic phenomena; Les Arcs, France (24 Jan 1987).

Narrow positron lines have been found in very heavy ion collisions which recently could also be connected with a correlated emission of electron lines of comparable energies. The experimental signature of these lines closely resembles the process of a back-to-back emission of an electron-positron pair. Nuclear internal pair conversion and the quasiatomic spontaneous emission of positrons are excluded as a conceivable explanation. The hypothesis of the existence of a light neutral object decaying into electron-positron pairs, widely discussed theoretically, has difficulties to explain the observed production cross sections and is not supported by subsequent experiments.

5063 **(GSI—87-45-Prepr.) Delta and pion abundancies in hot dense nuclear matter and the nuclear equation of state.** Cubero, M.; Schoenhofen, M.; Feldmeier, H.; Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750442/JAW.

Delta and pion abundancies in hot dense nuclear matter are calculated self-consistently with a relativistic mean-field model for different equations of state. The density of deltas turns out to be much more sensitive to the effective masses of the baryons than to the stiffness of the equation of state. The results are compared to experimental pion yields from intermediate-energy nucleus-nucleus collisions. The influence of deviations from thermal momentum distributions for the baryons is estimated.

5064 **(IAE—4205/2) Comparison of the l-forbidden Gamow-Teller β-transition in /sup 39/Ca with the O/sup -/ -> O/sup +/ β-transitions.** Khafizov, R.U. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700335/JAW.

The 0/sup -/ and 0/sup +/ beta-transitions in the region of light, medium and heavy nuclei as well as the l-forbidden Gamov-Teller beta-transition in /sup 39/Ca are considered within the scope of the finite fermi system theory. The value of the e/sub q5/=1.5 local axial charge, which is not sufficient to explain characteristics of the l-forbidden beta-transitions in /sup 39/Ca is obtained by comparing the theoretical calculations of the 0/sup -/-0/sup +/ beta-transition half-life with the experimental values. If a term, arising due to the tensor interaction, is added to the local e/sub q/ charge, then the experimental half-life of the l-forbidden beta-transition is λ=0.3 +- 0.005. 19 refs.; 2 tabs.

5065 **(IAE—4303/2) Effects of strong coupling with compound states in low-energy neutron scattering.** Danilin, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 Order Number DE88700344/JAW.

Analytical expression for scattering amplitude of neutrons on nuclei in cases of strong coupling with compound states and for absorption surface character as well as for valent neutron radiation capture cross section is derived. Strong coupling leads to a differ-

ence of this cross section shape from Breit-Wigner one even for isolated resonances and to another cross section shape in the overlapping resonance region. Considerable effect of single-particle resonance on the compound-resonance asymmetry and possibility of additional interference of elastic and inelastic amplitudes which leads to an additional shift of resonances in the elastic and radiation channel is shown. 16 refs.; 3 figs.

5066 **(IAE—4342/2) π-meson decays of surface λ-hypernucleus states.** Bychkov, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700359/JAW.

π/sup -/-decays of heavy Λ - hypernuclei are considered in quasiclassical approximation. It is shown that probability of decay is 10/sup 2/ times higher in the region $A \sim 200$ for surface hypernuclear states (SHS) as compared to the volume states. This fact can be considered as criterion for testing SHS hypothesis for Λ-hypernuclei. 12 refs.

5067 **(IAEA-R—4326-F) Development and refinement of an applicable, realistic version of the multistep compound reaction MSCR model for analysis of fast neutron cross sections needed for science and technology.** Marcinkowski, A. (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700360/JAW.

The theory of Feshbach-Kerman-Koonin has been applied for the calculations of preequilibrium particle emission in neutron initiated reactions with sequence of Mo-isotopes. It is supposed that the multistep compound interaction chain involves doorway-states containing bound particle orbitals. The bound-particle-hole state densities are used to derive the densities of states accessible in the transition modes contributing to the preequilibrium emission. Angular momentum dependence of transition and damping widths is taken into account. These features were introduced into EMPIRE code. Calculation of (n,2n) cross sections for Mo-isotopes with the non-closed shell and magic neutron number nucleus shows problems in description of cross sections combining multistep compound and direct processes. 14 refs, 4 figs.

5068 **(IFUSP-P—649) Refraction-diffraction interference in heavy-ion elastic angular distributions.** Pato, M.P.; Hussein, M.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700370/JAW.

A new representation of the refractive and diffractive parts of the elastic scattering amplitude is derived. Application is made to the elastic scattering of /sup 13/C + /sup 12/C at E/sub lab/ = 260.00 MeV.

5069 (INIS-mf—11041, pp 289-295) **Do the bound and free nucleons look the same?.** Staszel, M.; Rozynek, J.; Wilk, G. (Warsaw Univ., Poland. Inst. Fizyki Doswiadczalnej; Institute of Nuclear Research, Warsaw, Poland). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Guided by the deep inelastic μA (A=Fe,D) scattering data we present a simple parametrization of the structure functions of nucleons bound in nuclei. The nuclear binding is represented by the effective mass of nucleons; the large momentum tail of nuclear wave function is also included. A good agreement with data in the whole range of the scaling variable x is obtained.

5070 (INIS-mf—11041, pp 307-316) **Central nucleus-nucleus collisions.** Pajares, C. (Universidade de Santiago de Compostela, Spain Dept. de Fisica Teorica). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

Different momenta distributions of central nucleus-nucleus collisions in the multichain model are evaluated. The average number of particles obtained and the height of the plateau indicate that for $\sqrt{s} = 31$ GeV the phase transition from hadronic matter to quark-gluon plasma can take place, even for collisions of not very heavy nuclei, if thermalization occurs. Obtained results are coompared with the existing experimental information.

5071 **(ISN—85-100) Attempt at a semiclassical solution of the Bethe Goldstone equation for nuclear matter.** Schuck, P.; Suraud, E. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1985. 9p. (CONF-850914—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750109/JAW.

From Phase space approach to nuclear dynamics meeting; Miramare, Trieste, Italy (30 Sep 1985).

We propose a semiclassical scheme for calculating the Bruckner T - matrix at finite temperature. This prescription should allow to derive a temperature dependent effective interaction for the nucleus. Preliminary encouraging results are presented in the zero temperature case.

5072 **(ISN—86-70) Study of heavy ion deep inelastic scattering with masses $\leqq$ 60.** Bonnafond, C. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1986. 109p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753223/JAW.

The classical friction model which was used successfully to describe deep inelastic collisions between heavy ions, is used for light systems like /sup 20/Ne + /sup 59/Co at around 8 MeV/A of incident energy. This model is based on a Fokker-Planck equation with the hypothesis of a surface friction between the ions. The following variables are considered: the relative distance between the ions, their relative angular momentum, their individual deformations at the charge and mass transfer and the conjugate variables. Multidifferential cross-sections are calculated and compared with experimental results. The agreement is generally as good as in the case of heavier systems. The results are obtained with the same parameters, however some discrepancies appear in the energy loss and charge transfer. An experiment with the same system but at higher incident energy (760 MeV) has been performed in order to study the evolution of deep inelastic processes between 7.5 to 38 MeV/A. Angular and charge distributions show up an increasing role of direct processes which cannot be reproduced within the friction model.

5073 **(ISN—86-94) Dynamical study of symmetries: breaking and restauration.** Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Sep 1986. 68p. (In French). (CONF-8609338—1). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750262/JAW.

From Joliot Curie school of nuclear physic: symmetries and nuclear physics; Maubuisson, France (15 Sep 1986).

First symmetry breaking (spontaneous) is explained and the physical implication discussed for infinite systems. The relation with phase transitions is indicated. Then the specific aspects of symmetry breaking in finite systems is treated and illustrated in detail for the case of translational invariance with the help of an oversimplified but exactly solvable model. The method of projection (restauration of symmetry) is explained for the static case and also applied to the model. Symmetry breaking in the dynamical case and for instance the notion of a soft mode responsible for the symmetry breaking is discussed in the case of superfluidity and another exactly solvable model is introduced. The Goldstone mode is treated in detail. Some remarks on analogies with the breaking of chiral symmetry are made. Some recent developments in the theory of symmetry restauration are briefly outlined.

5074 **(ISN—86-107) Multiphonon method as a dynamical approach to octupole correlations in deformed nuclei.** Piepenbring, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Sep 1986. 49p. (CONF-8609190—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750090/JAW.

From 18. summer school on nuclear structure studies by means of nuclear reactions; Mikolajki, Poland (1 Sep 1986).

The octupole correlations in nuclei are studied within the framework of the multiphonon method which is mainly the exact

diagonalization of the total Hamiltonian in the space spanned by collective phonons. This treatment takes properly into account the Pauli principle. It is a microscopic approach based on a reflection symmetry of the potential. The spectroscopic properties of double even and odd-mass nuclei are nicely reproduced. The multiphonon method appears as a dynamical approach to octupole correlations in nuclei which can be compared to other models based on stable octupole deformation. 66 refs.

5075 **(ISN—86-112) Some basic aspects of semiclassical and phase space approaches to the physics of the nucleus.** Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Dec 1986. 31p. (CONF-8604360—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750264/JAW.

From School on semiclassical methods in nuclear physics; Barcelona, Spain (7 Apr 1986).

In these lectures, the meaning and the validity of the usual Wigner Kirkwood $h/2\pi$ expansion of the nuclear density matrix are discussed. The leptodermous nature of the (nuclear) phase space has been stressed and it has been outlined that the Wigner Kirkwood expansion represents the leptodermous expansion of the Wigner transform of the density matrix in terms of distributions in very close analogy to what is known as the nuclear leptodermous expansion of the local density in real space. The significance and the convergence properties of the Wigner Kirkwood expansion have been illustrated. We show how the Wigner Kirkwood $h/2\pi$ expansion can be applied to scattering problems and to the calculation of the Green's function. A short outline how this theory can be applied for the calculation of the Brueckner - G matrix has been given. An important ingredient to semiclassical physics consists in its applicability to angular momentum projected quantities. It is briefly sketched how this task can be dealt with. An important issue is the extension of Wigner Kirkwood theory to the calculation of correlation function and for instance of the linear response function. We first show how this can be achieved for the ph level density and apply it then successfully to the nuclear structure function at high momentum transfer in the quasielastic peak region. At the end we give a possible way of a semiclassical WKB - like quantisation of the interaction response. This could be used for an economic calculation of the positions of collective nuclear states.

5076 **(ISN—87-22) ENSDF: a nuclear structure data bank for nuclear physicists.** Blachot, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Feb 1987. 5p. (In French). (CONF-8703177—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750263/JAW.

From 9. biennial session of nuclear physics; Aussois, France (9 Mar 1987).

Data Banks have tremendously grown these last years. All the nuclear Structure information are now in the ENSDF. This file is used for the Nuclear Data Sheets publication. The part which contains only Adopted Data could be used as a Data Bank for Nuclear Physicists. Examples of retrevial are given.

5077 **(JYFL—23/86) EPM calculations of E2/M1 mixing ratios for even samarium isotopes "1"4"6"-"1"5"2Sm.** Suhonen, J. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Dec 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753042/JAW.

The M1 operator and the E2/M1 mixing ratios, Δ(E2/M1), are discussed in the framework of the extended phonon projection model (EPM). The model is applied to the even-even samarium isotopes "1"4"6"-"1"5"2Sm to describe their M1 properties. Comparison is made between the EPM, the consistent-Q formalism (CQF) of the basic interacting-boson approximation (IBA-1) and the experimental Δ(E2/M1) data. Both theoretical approaches display reasonably good model-parameter systematics. The EPM describes nicely also the finer details of the low-energy spectrum including the electromagnetic quantities.

5078 **(KFK—4248) Density dependent effective interactions and the determination of nuclear densities in double-folding model analyses of elastic alpha-particle scattering.** Gils, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jul 1987. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750443/JAW.

Different forms for the density dependence of two-body effective interactions are empirically studied in double-folding model analyses of elastic alpha-particle scattering at E/sub α/ = 104 MeV and 140 MeV. The main aspects of the calculations, which are based on the M3Y-interaction, are the analytical parametrisation of the density dependence and the appropriate consideration of the target and projectile density in the overlap region. For the latter purpose different relative weights of the densities were introduced, which also simulate density gradient effects. Besides the need for a separate treatment of the target and projectile densities in particular the different relative weights are found to be important. With the new modifications suggested in this study consistent results are obtained for the various parametrisations and these results are in agreement with previous implicit folding interpretations of nucleon scattering data. The results are finally discussed with regard to the ability of getting information about nuclear matter distributions and a comparison with single-folding models is made. It is concluded that double and single-folding models are equivalent when empirical adjustments of parameters are to be made in order to obtain reasonably good fits to the experimental data.

5079 (LA—10956-C, pp 141-160) **Some open questions in nuclear physics.** Henley, E.M. (Univ. of Washington, Seattle). Apr 1987. NTIS, PC A12/MF A01. Order Number DE87012707/JAW. (CONF-8610183—).

From 20. LAMPF Users Group meeting; Los Alamos, NM, USA (27 Oct 1986).

The author discusses a broad range of topics to be explored in nuclear and high energy physics under five basic headings: nuclear structure, quarks and gluons in nuclei, quark-gluon matter, symmetry principles and rare particle decay. Under each heading specific problems and experimental approaches are briefly outlined. For example, outstanding nuclear structure questions listed include giant resonance at high energies and stability in superheavy elements; under symmetry principles, CP invariance is discussed; and, in the rare decay section, muon and kaon decays are considered.

5080 **(LBL—23551) High-spin research with HERA [High Energy-Resolution Array].** Diamond, R.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 51p. (CONF-8705188—2). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000473/JAW.

From 25. winter school on nuclear structure; Zakopane, Poland (1 May 1987).

The topic of this report is high spin research with the High Energy Resolution Array (HERA) at Lawrence Berkeley Laboratory. This is a 21 Ge detector system, the first with bismuth germanate (BGO) Compton suppression. The array is described briefly and some of the results obtained during the past year using this detector facility are discussed. Two types of studies are described: observation of superdeformation in the light Nd isotopes, and rotational damping at high spin and excitation energy in the continuum gamma ray spectrum.

5081 **(LPCC-T—86-01) Experimental and theoretical aspects of pionization in nuclear collisions below 100 MeV per nucleon.** Durand, D. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire). Jan 1986. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750235/JAW.

Pion production in nuclear collisions below 100 MeV per nucleon is investigated in both experimental and theoretical point of view. In a first experimental part and after a brief review of the already existing set-ups, the conception and the first beam tests of a spectrometer for the detection of charged pions are described. A detailed analysis of the results obtained up to now concludes this first part. In a second theoretical part and after a review of the models proposed in the literature, three original studies are present-

ed. The first one is an extension of the Shyam-Knoll model to a coincidence calculation so allowing to test this model in the frame of a semi-exclusive kind of experiment; the second one is a calculation of the production by nucleon-nucleon inelastic collisions in a hot expanding Fermi gas; finally, the third one shows, with help of a schematic model, the importance of the effects of pion re-absorption in the medium. These whole studies show that pion production at the considered energies is still an open problem. 47 refs.

5082 **(RAL—87-027) Factorisation scale independence, the connection between alternative explanations of the EMC effect and QCD predictions for nuclear properties.** Close, F.E.; Roberts, R.G.; Ross, G.G. (Rutherford Appleton Lab., Chilton (UK)). May 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750207/JAW.

Different models are examined for deep inelastic scattering in nuclei in the context of the operator product expansion where the operator matrix elements involve a factorisation scale characterising the separation of short or long distance physics. By exploiting the independence of physical quantities upon this scale seemingly different models for the nucleus can be connected, such as dynamical rescaling and the standard convolution models of nuclear physics, allowing nuclear properties to be simply expressed in terms of the anomalous dimensions of QCD. A discussion is carried out of how non-convolution contributions may also be described by dynamical rescaling and it is shown how to extend dynamical rescaling to describe spin dependent quantities.

5083 **(UCRL—97345) Recent developments and applications for precompound nuclear theory.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 19p. (CONF-8710181—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000221/JAW.

From International Atomic Energy Agency advisory group meeting on nuclear theory for fast neutron nuclear data evaluation; Beijing, China (12 Oct 1987).

New considerations on consistent effective level densities for precompound decay are reviewed and tested for the hybrid model formulation. The importance of using realistic single particle levels for few quasi-particle densities is illustrated via (p,n) reactions on four Zr isotope targets. Some review is given of combinations of precompound plus Hauser-Feshbach approaches. The status of semi-classical and quantal approaches to calculating angular distributions is also discussed. We present comparisons of experimental and calculated angular distributions, particle spectra and excitation functions for reactions with nucleons and heavy ions up to and beyond 100 MeV, as examples of data being requested by modern technology. 43 refs.

5084 **Algebraic approach to the two-Skyrmion system.** Oka, M.; Bijker, R.; Bulgac, A.; Amado, R.D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 1727-1736(Nov 1987).

The algebraic structure of the two-Skyrmion system is studied by using bosonic quantization of the rotation of the Skyrmion. The adiabatic interbaryonic potential is expressed in terms of boson operators and the large n (number of bosons) behavior is investigated. By identifying n with N/sub c/ (number of colors in quantum chromodynamics), 1/n correction terms for realistic n = N/sub c/ = 3 are studied.

5085 **Model for tunneling in many-particle systems.** Arve, P.; Bertsch, G.F.; Negele, J.W.; Puddu, G. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2018-2025(Nov 1987).

A model is proposed for studying tunneling in many-particle systems that is simple enough to solve and realistic enough to test various collective models of multidimensional barrier penetration. We find that the imaginary time dependent mean-field theory works very well in its domain of applicability, as does a continuum hopping approximation. The usual cranked mean field approximation is much less reliable.

5086 **Green's function Monte Carlo study of light nuclei.** Carlson, J. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2026-2033(Nov 1987).

The first Green's function Monte Carlo calculations of A = 3 and 4 nuclei with spin-dependent interactions are reported. Green's function Monte Carlo methods for calculating the properties of coupled channel quantum systems are described in detail, including both exact and approximate schemes. Results are presented for A = 3 and 4 nuclei with a V6 interaction. For the triton, the Green's function Monte Carlo calculations are compared with Faddeev and variational methods. Green's function Monte Carlo calculations of the alpha particle provide the first test of variational methods for systems with spin-dependent interactions. For this interaction, variational methods underestimate the binding energy of the alpha particle by ≃2 MeV. Other ground state properties of light nuclei have also been determined. Implications of these results for more realistic interactions are discussed, along with the possibility of future extensions of Green's function Monte Carlo methods to treat momentum dependent and three nucleon interactions.

5087 **Rotational model and shell model pictures of magnetic dipole excitations.** Liu, H.; Zamick, L. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2057-2063(Nov 1987).

A comparison is made of the rotational model and the large shell model for the calculation of the magnetic dipole excitations in selected nuclei in the s-d and f-p shells. Focus is given on both the relatively low lying strong states and higher "spin flip" excitations. It is found that the two models agree fairly well for summed B(M1) strength, but for the deformations that were used give different results for orbital and spin decomposition. The rotational model yields too much low lying strength as compared with the shell model. A technique for eliminating spurious contributions to the summed strength in the rotational model is developed. It is shown that in the asymptotic limit in some nuclei the magnetic dipole excitations are purely orbital. The implications of these calculations to results in heavier deformed nuclei for "scissor mode" excitations is discussed.

5088 **Collective magnetic multipole excitations in open shells: /sup 48/Ti.** Liu, H.; Zamick, L. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2064-2068(Nov 1987).

The magnetic multipole even-parity transitions are calculated in /sup 48/Ti with a mind to finding interesting collective behavior and to study the effects of increasing the model space. The single-j shell signature selection rules are compared to those in the neutron-proton interacting boson model with good F spin. There are similarities but also differences. Some behavior of the single-j shell calculation survives as the model space increases, e.g., low lying collective M1 and M7 modes. Configuration mixing is, however, vital to describe the M3 and M5 modes as well as the spin flip M1 modes. The distribution of strength between lower and higher isospins is discussed. Results are compared with calculated transitions in /sup 42/Sc. It appears that allowing one-particle excitations from the single-j shell gives the pattern of the strength distribution; the further addition of two-particle excitations leads to a quenching of the strength distribution.

5089 **Quark cluster model for nuclear matter.** Koltun, D.S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2047-2056(Nov 1987).

A model of nuclear matter is given in which nonrelativistic quarks, carrying color, moving in one dimension, interact through a contact interaction. Solutions for the ground-state energy as a function of density may be found exactly using a method based on the Bethe ansatz, which is explained in detail. The model system shows characteristic behavior of a Fermi gas of nucleons (bound clusters

of quarks) at low density, and of a Fermi gas of free quarks at high density, with a smooth transition between these limits.

5090 **Spatial development of inelastic scattering and particle transfer cross sections in very heavy ion reactions.** Baltz, A.J.; Goldfarb, L.J.B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 1807-1809(Nov 1987). Contract AC02-76CH00016.

A quantal method is presented to investigate the spatial development of inelastic scattering cross sections in heavy ion reactions. Application is made to the case of 1120 MeV /sup 208/Pb+/ sup 238/U(0^+,2^+,...,40^+).

5091 **Current conservation and interaction currents in relativistic meson theories.** Gross, F.; Riska, D.O. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185 and Continuous Electron Beam Accelerator Facility, Newport News, Virginia 23606). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 1928-1941(Nov 1987).

The relation between the nucleon-nucleon interaction and exchange currents needed for current conservation are derived for the Bethe-Salpeter formalism, and for the approach in which the spectator particle is restricted to its mass shell. For both approaches, it is shown how to achieve current conservation for a completely general isospin dependent, energy dependent interaction with arbitrary phenomenological electromagnetic form factors for the nucleon and mesons, and with strong form factors at the meson-nucleon vertices. Contrary to what has often been stated in the literature, the development shows that current conservation places no restrictions on the use of different electromagnetic form factors for mesons and nucleons, and that phenomenological meson-nucleon form factors can be introduced in a way which is consistent with current conservation. The longitudinal part of the exchange current is uniquely determined by current conservation, and for the common case of an interaction that only depends on the invariant momentum transfer variable an explicit expression for this longitudinal exchange current is given. The transverse part, which contains all electromagnetic form factors, is unconstrained by current conservation.

5092 **Microscopic optical-potential analysis of charge-symmetry violation in π/sup +- / elastic scattering from ^{3}H and ^{3}He.** Kim, K.T.; Kim, Y.E.; Landau, R.H. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 5, 2155-2158(Nov 1987).

Charge symmetry violation due to the Coulomb force in the elastic scattering of π/sup +- / from ^{3}H and ^{3}He is studied using a theoretical optical potential with spin. Our calculated results compare favorably with the experimental differential cross sections of Kaellne et al. and of Nefkens et al., indicating that the observed violation of the charge symmetry can be due to direct Coulomb effects.

5093 **Monte Carlo techniques for ground-state properties.** Schmidt, K.E. (Department of Chemistry and Courant Institute of Mathematical Sciences, New York Univeristy, New York, NY. 10003). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 19-29(30 Oct 1987). (CONF-8704193—).

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

Monte Carlo calculations of the ground-state properties of various few-body systems are described. The variational Monte Carlo method is used to calculate upper bounds to the ground-state energy. The resulting variational wave functions can be used to calculate other properties such as the density profile and potential and kinetic energies. Typically, the variational trial functions are also used as the initial and guiding functions in the Green's function Monte Carlo (GFMC) method, which can solve for the ground-state of the Schroedinger equations with only statistical errors. The GFMC method is described and its intimate relationship with path integral techniques shown. The fermion problem is discussed. Results for variational and GFMC calculations in ^{5}He as well as various atomic systems are discussed.

5094 **Deuteron-nucleus collisions: Reduction of a many-fermion collision system to an equivalent three-body model.** Kozack, R.; Levin, F.S. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 111-130(30 Oct 1987). (CONF-8704193—).

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

Elastic scattering and breakup of deuterons by nuclei are strongly coupled processes usually treated together theoretically by means of a three-body model. This model consists of the neutron (n) and proton (p) forming the deuteron, and a structureless core (A) representing the unexcited target nucleus. Their collision dynamics is governed by an empirical Hamiltonian H/sub M/ which consists of the kinetic energy operators, the neutron—proton interaction V/sub n//sub p/ which binds the deuteron, plus neutron—nucleus and proton—nucleus absorptive interactions. These latter are the relevant optical potentials evaluated at half the bombarding energy. Although H/sub M/ has been successful in fitting data up to deuteron energies of 400 MeV, only very recently have some of the underlying theoretical problems been solved. The most fundamental problem is the reduction of the deuteron—ucleus, many-fermion Hamiltonian H/sub A//sub +2/ to an equivalent three-body Hamiltonian H_3 which describes those collisions in which the target nucleus remains unexcited.

5095 **Coincidence reactions and the three-body structure of ^{6}Li.** Lehman, D.R. (The George Washington University, Washington, D.C. 20052). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 131-144(30 Oct 1987). (CONF-8704193—).

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

This paper concerns two of the three virtual disintegration amplitudes of ^{6}Li that are possible below the ^{3}He—^{3}H threshold: ^{6}Li→α+d and ^{6}Li→p+(nα). These amplitudes embody the three-body nature of ^{6}Li at low-excitation energies and thereby serve as a testing ground for three-body models of ^{6}Li. The current status of a three-body approach to the dynamics of these amplitudes is given. Emphasis is placed on the physics underlying the three-body approach and the results obtained. The theoretical predictions for the ^{6}Li→α+d and ^{6}Li→p+(nα) momentum distributions are compared to new data from the kinematically optimized coincidence reaction ^{6}Li(e,e'd) ^{4}He and existing data from ^{6}Li(p,2p)nα, respectively.

5096 **Intermediate energy nuclear physics with electrons.** Moniz, E.J. (Bates Linear Accelerator Center, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *AIP (American Institute of Physics) Conference Proceedings;* **161**: No. 1, 189-205(10 Oct 1987). (CONF-8610239—).

From Electron scattering in nuclear and particle science: in commemoration of the 35th anniversary of the Lyman-Hanson-Scott experiment; Urbana, IL, USA (23 Oct 1986).

Inclusive electron scattering has made an enormous contribution to our understanding of hadron and of nuclear structure and to defining the questions which are driving the field in new directions. With intense CW intermediate energy electron beams and with the opportunity to exploit spin observables, central contributions to many of the most crucial questions are anticipated. (AIP)

5097 **Angular distributions of high energy gamma rays from heavy-ion collisions via an n-p bremsstrahlung interpretation.** Remington, B.A.; Blann, M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1387-1396(Oct 1987). Contract W-7405-ENG-48.

We have explored the viability of incoherent npγ bremsstrahlung as the dominant mechanism for the production of high energy γ rays in heavy-ion collisions by comparing the calculated relative angular distributions with experimental results. We have utilized the Boltzmann master equation model of heavy-ion collisions to decompose the reaction into first- and higher-order colli-

sion components in the assumed nucleon-nucleon cascade of the relaxation process. Within this decomposition we treat the γ-ray angular distribution of the first collision component by adopting a semiclassical npγ bremsstrahlung formula. The multiple collision component is assumed to contribute isotropically in the nucleus-nucleus center-of-mass system, and the Boltzmann master equation model enables us to weight these two components relative to one another. We then compare the predictions of our model with the available experimental results, finding generally favorable agreement between model and data. Within the uncertainties of our calculation and the data, the predicted angular distributions are consistent with an incoherent npγ bremsstrahlung mechanism as the source of high energy γ rays in intermediate energy heavy-ion collisions.

5098 **α-cluster hypernuclei /sub ΛΛ//sup 5/He, /sub ΛΛ//sup 6/He, /sub Λ//sup 9/Be, /sub ΛΛ//sup 10/Be and hypernuclear interactions.** Bodmer, A.R.; Usmani, Q.N. (Illinois Univ., Chicago, USA. Dept. of Physics; Argonne National Lab., IL, USA. Physics Div.; Jamia Milia Islamia, New Delhi, India. Dept. of Physics; Illinois Univ., Urbana, USA. Dept. of Physics). *Nuclear Physics [Section] A;* **468**: No. 3/4, 653-668(Jul 1987). Contract W-31-109-ENG-38.

Variational calculations for /sub ΛΛ//sup 6/He, /sub Λ//sup 9/Be and /sub ΛΛ//sup 10/Be have been made with n/sub α/α-n/sub Λ/Λ cluster models. Various αΓ potentials are considered, all of which reproduce B/sub Λ/(/sub Λ//sup 5/He). Some of the V/sub αΛ/ are obtained from an αΛ model by a folding procedure using effective ΛN and ΛNN forces; realistic V/sub αΛ/ are also obtained from 4N-Λ Monte Carlo variational calculations of /sub Λ//sup 5/He. These MC V/sub αΛ/ include many-body effects which give a central hump even with only ΛN forces. /sub Λ//sup 9/Be is overbound by about one MeV with realistic αα and αΛ potentials, even with reasonable estimates of ΛN exchange effects which give a reduction ≃ 0.5 MeV. Repulsive ΛNN forces which can account for the overbinding of /sub Λ//sup 5/He give rise to a repulsive ααΛ potential which brings the calculated B/sub Λ/(/sub Λ//sup 9/Be) into good agreement with the experimental energy. The ΛΛ interaction strengths are obtained from /sub ΛΛ//sup 6/He and /sub ΛΛ//sup 10/Be for a number of ΛΛ potential shapes. The strengths obtained from /sub ΛΛ//sup 10/Be underbind /sub ΛΛ//sup 6/He by more than one MeV for all our ΛΛ and αΛ potentials. The ΛΛ interaction obtained from the well established /sub ΛΛ//sup 10/Be event is found to be quite strongly attractive, comparable to the /sup 1/S/sub 0/ NN interaction without OPE, with correspondingly large negative ΛΛ scattering lengths of ≃ -4 to -5 fm.

5099 **Three-body forces.** Nefkens, B.M.K. (University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 719-726(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A review of current knowledge of three-body forces from experimental and theoretical standpoints is given. The 3-H and 3-He nuclei are discussed. Also, nucleon scattering from deuterium is discussed. (AIP)

5100 **Finite temperature mean field calculations with isobars.** Miller, H.G.; Quick, R.M.; Vary, J.P.; Fabian, W. (Theoretical Physics Divison, NRIMS, CSIR, Pretoria, South Africa). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 877-878(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Finite Temperature Hartree Fock (FTHF) calculations have been performed in ^{4}He in a quasiparticle basis which contains nucleons as well as Δ(1232) isobars. For temperatures less than 10 MeV, the isobar admixture probabilities are negligibly small.

5101 **Search for anomalously heavy isotopes of low Z nuclei.** Nitz, D.; Ciampa, D.; Hemmick, T.; Elmore, D.; Kubik, P.W.; Olsen, S.L.; Gentile, T.; Kagan, H.; Haas, P.; Smith, P.F.; and others. (Department of Physics, University of Michigan, Ann Arbor, MI 48109). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1143-1147(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We present preliminary results of a search for anomalously heavy isotopes of certain light elements using an electrostatic charged particle spectrometer in conjunction with the MP tandem accelerator facility at the Nuclear Structure Research Laboratory of the University of Rochester. New limits for the existence of anomalous, heavy isotopes (100—10,000 amu) in ordinary, terrestrial Li, Be, B and F samples and enriched H^2, C^{13}, and O^{18} samples are reported.

5102 **P-bar-nucleus interaction.** Peng, J.C. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 499-504(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Status and future prospects of p-bar-nucleus scattering experiments are presented.

5103 **Production of high energy density in N-bar-nucleus interactions.** Gibbs, W.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 505-514(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The results of an investigation of p-bar-(and to a lesser extent) d-bar-nucleus interactions are reported. The technique involves following the classical production and propagation of mesons (π, K^+, K^0, K^-, K-bar^0, K/sup */, eta, ω, phi) and baryons (N, Λ, Σ) in nuclei after antiparticle annihilation. It is found that small regions of the nucleus can be raised to sufficiently high energy densities that some predictions of a quark-gluon phase transition can be tested with the use of energetic antiprotons (5—10 GeV/c). The strangeness signal is examined and compared with the amount of strangeness produced in a recent experiment with 4 GeV/c incident antiprotons. A general expression is given for the total amount of strangeness produced which is invariant under intranuclear strangeness exchange reactions.

5104 **Continuum shell model analysis $^{16}O(\gamma,p)^{15}N$ at medium energies.** Ludeking, L.D.; Cotach, S.R. (North Carolina State University, Raleigh, N.C. 27695-8202). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 542-546(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A coupled-channel calculation based on a continuum shell model formulation, is reported for $^{16}O(\gamma,p)^{15}N$ at energies between 50 and 400 MeV. The sixteen particle Hamiltonian is diagonalized in a truncated, but realistic model space spanned by products of continuum single-particle states and bound states of the A = 15 system. All non-localities arising from antisymmetrization, Pauli blocking, and exchange are rigorously retained. Using the complete effective two-body interaction which describes the ^{16}O giant dipole resonance, a quantitative description is obtained for the photonuclear cross section for energies above 300 MeV it is necessary to include all electric and magnetic transitions up to Ell and M9, respectively, to achieve convergences for the multipole expansion. Preliminary calculations involving explicit Δ isobar degrees of freedom are also reported and briefly discussed.

5105 **Elastic meson-nucleon partial wave scattering analyses.** Arndt, R.A. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 650-656(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Comprehensive analyses of π-n elastic scattering data below 1100 MeV(Tlab), and K+p scattering below 3 GeV/c(Plab) are discussed. Also discussed is a package of computer programs and data bases (scattering data, and solution files) through which users can "explore" these interactions in great detail; this package is known by the acronym SAID (for Scattering Analysis Interactive Dialin) and is accessible on VAX backup tapes, or by dialin to the VPI computers. The π-n, and k+p interactions will be described as seen through the SAID programs. A procedure will be described for generating an interpolating array from any of the solutions encoded in SAID; this array can then be used through a fortran callable subroutine (supplied as part of SAID) to give excellent amplitude reconstructions over a broad kinematic range.

5106 **Dudley's dilemma: Magnetic moments in relativistic theories.** McNeil, J.A. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104 and Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 696-709(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

In 1975 L. Dudley Miller showed how the basic phenomenology of the major shell and spin-orbit splittings constrained the relativistic scalar/vector structure model to values of the potentials incompatible with the observed magnetic moments of nuclei one nucleon away from closed shell [1]. In this talk the resolution of this problem is presented from three different perspectives. First a self-consistent Landau-Migdal approach is used to define the single particle isoscalar current in infinite nuclear matter. The constraint of self-consistency provides a vector suppression factor to the single particle current which returns the current to its nonrelativistic form and resolves the problem. The same suppression factor is shown to follow as well from either a consideration of gauge invariance or (equivalently) the relativistic random phase approximation. Local density approximation calculations of isoscalar magnetic moments of nuclei one nucleon away from closed shell recover the Schmidt values, thus resolving this longstanding problem.

5107 **Spin observables at intermediate energies: A tool in viewing the nucleus.** McClelland, J.B. (Los Alamos National Laboratory, Los Alamos, NM 85745). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 751-761(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Experimental determination of recent advances in spin observables in nuclei is reviewed. Data from elastic and charge-exchange proton scattering from 13-C, 40-Ca, 90-Zr, and 208-Pb at proton energies ranging from 100—1000 MeV are discussed.

5108 **Nuclear-like states of quark matter.** Goldman, T.; Schmidt, K.E.; Stephenson G.J. Jr. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 773-775(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We show that, in a world with only one flavor of light quark, QCD suggests that the low energy states of quark matter are similar to nuclei, but are not well represented as collections of baryons. Except for the existence of open nucleon channels, the same would be true for the actual, two-light-flavor world.

5109 **Collective flow and the stiffness of compressed nuclear matter.** Keane, D.; Beavis, D.; Chu, S.Y.; Fung, S.Y.; Gorn, W.; Liu, Y.M.; VanDalen, G.; Vient, M.; Molitoris, J.J.; Stoecker, H.; and others. (Department of Physics, University of California, Riverside, California 92521). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 844-847(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Sideward flow parameters for Ar+KCl at 1.2 and 1.8 A GeV are compared with VUU model predictions for different nuclear equations of state. This model indicates that compressional effects are needed to account for the observed flow. Various uncertainties hinder a precise determination of the compressibility; our current best estimate lies somewhere between the so-called "medium" and "stiff " equations of state.

5110 **Relativistic wave functions in kaon photoproduction from nuclei.** Bennhold, C.; Wright, L.E. (Ohio University, Athens, Ohio 45701). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 914-916(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Photoproduction of positively charged kaons from light nuclei is used to investigate the effect of relativistic bound state wave functions. These nuclear and hypernuclear shell model states are obtained by solving the Dirac equation with scalar and time-like vector Woods-Saxon potentials, which have been adjusted to fit binding energies. The calculations have been performed in momentum space to treat non-localities from the production operator straightforwardly and to include Fermi motion. Significant relativistic effects are found in the full non-local calculation, but appear much reduced in a local frozen nucleon approximation.

5111 **Correlations in hypernuclei.** Buettgen, R.; Holinde, K.; Holzenkamp, B.; Speth, J. (Institut fuer Kernphysik der KFA Juelich, D-5170 Juelich, West Germany). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 924-929(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We investigate the relationship between the free AN-interaction and the effective interaction inside of a nucleus. These polarization effects are taken into account within a generalized Brueckner G-matrix. Within this approximation we calculate the Landau-parameters in the AN-system and compare the correlated AN- and NN-wavefunctions in nuclear matter.

5112 **Eta-mesic nucleus; A new nuclear species?.** Liu, L.C.; Haider, Q. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 930-933(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The strong-interaction dynamics of the etaN system can cause the eta meson to be captured into nuclear orbitals in nuclei with mass numbers greater than 10. We present our prediction for what should be the experimental signature of the formation of an eta-mesic nucleus and describe briefly a forthcoming experiment at Brookhaven. The scientific significance of eta-mesic nuclei is also discussed.

5113 **Modern implications of neutrons β-decay.** Freedman, S.J. (Argonne National Laboratory, Argonne, IL 60439-4843). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1125-1130(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The ratio of the axial-vector to vector coupling constant for neutron decay is best determined by recent neutron β-asymmetry experiments. The new value of g/sub A//g/sub V/ resolves serious discrepancies in neutron lifetime measurements. Predictions of theories using g/sub A//g/sub V/ as input are seriously modified.

5114 **Comparison of beta-ray polarizations in Fermi and Gamow-Teller transitions and SU(2)/sub L/ x SU(2)/sub R/ x U(1) models.** Herczeg, P. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 1131-1133(15 Oct 1986). (CONF-860575—).

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We analyze the information on SU(2)/sub L/ x SU(2)/sub R/ x U(1) models provided by measurements of the ratio of beta-ray polarizations in Fermi and Gamow-Teller transitions.

5115 **Neutrino mass, double beta decay and neutrino oscillations.** White, D.H. (Dept. of Physics, Brookhaven National Lab., Upton, NY 11973). pp 239-241 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The paper discusses three topics, the direct measurement of the neutrino mass, double beta decay and various searches for oscillations. There is interest in these topics from a broad range of individuals that have not worked closely in the field. Accordingly, this introduction is aimed primarily at the non-expert.

5116 **Giant resonances - Why protons.** Bertrand, F.E. (Oak Ridge Lab., Oak Ridge, TN). pp 181-232 of Studying nuclei with medium energy protons. Vancouver, BC Canada; TRIUMF (1983). (CONF-8307100—).

From TRIUMF workshop on studying nuclei with medium energy protons; Alberta, Canada (11 Jul 1983).

This paper discusses the interaction of protons with nuclei and use of the protons for studies of giant resonances. The protons excite giant resonances, indeed the systematic establishment of the existence of the first non-dipole giant resonance, the giant quadrupole resonance (GQR) came from the use of inelastic proton scattering. The author discusses how the proton "stack up" for such studies when compared to the use of other hadronic probes.

5117 **Polarization phenomena in N-nucleus scattering.** Moss, J.M. (Los Alamos National Lab., Los Alamos, NM). pp 384-398 of Studying nuclei with medium energy protons. Vancouver, BC Canada; TRIUMF (1983). (CONF-8307100—).

From TRIUMF workshop on studying nuclei with medium energy protons; Alberta, Canada (11 Jul 1983).

Polarization observables will play an increasingly important role in future studies of nuclei with medium-energy (ME) protons. This may be stated without much chance of future contradiction. There are many issues in nucleon-nucleus physics that could be dramatically affected. The author presents a couple of current examples of polarization experiments, and also discusses two future experiments in which qualitatively new information will be obtained. The emphasis in this paper is on the physics that cannot be obtained from other hadronic or electromagnetic experiments.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 4115, 4116, 5040

5118 **(CEA-CONF—8884) Monte Carlo method in radiation transport problems.** Dejonghe, G.; Nimal, J.C.; Vergnaud, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Nov 1986. 40p. (In French). (CONF-8611190—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750077/JAW.

From Conference on statistics and scientific calculus; Rouen, France (20 Nov 1986).

In neutral radiation transport problems (neutrons, photons), two values are important: the flux in the phase space and the density of particles. To solve the problem with Monte Carlo method leads to, among other things, build a statistical process (called the play) and to provide a numerical value to a variable x (this attribution is called score). Sampling techniques are presented. Play biasing necessity is proved. A biased simulation is made. At last, the current developments (rewriting of programs for instance) are presented due to several reasons: two of them are the vectorial calculation apparition and the photon and neutron transport in vacancy media.

5119 **(CTH-RF—57) Recent calculational work at Department of Reactor Physics CTH.** Sjoestrand, N.G. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics). Mar 1987. 8p. (CONF-8703179—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753368/JAW.

From Status of reactor calculation in Nordic countries; Helsinki, Finland (31 Mar 1987).

Short presentations are given of benchmark calculations for some two-medium problems with one group of neutrons. Monte Carlo calculations using the MORSE code are one group of neutrons. Monte Carlo calculation for the design of a neutron collimator for neutron spectrum measurements at JET.

5120 (INDC(CCP)—275/L, pp 17-26) **Transmission function measurements, evaluation of mean resonance parameters and group constants for /sup 235/U in the unresolved resonance region.** Van'kov, A.A.; Gosteva, L.S.; Ukraintsev, V.F.; Toshkov, S.; Yaneva, N. Jun 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700019/JAW.

Original report in Russian was distributed as INDC(CCP)-244/G.

In Translation of selected papers published in Nuclear Constants 1, 1985.

An analysis of experimental average transmission and cross-sections data for /sup 235/U was carried out using the multilevel theory. A new evaluation for mean resonance parameters and group constants of /sup 235/U was made in the energy region 0.1-21.5 keV. 12 refs, 2 figs, 5 tabs. Translated from Russian.

5121 (INIS-mf—10996, pp 45-47) **Measurement of the attenuation of 14 MeV neutrons in building materials used for houses in Austria.** Staffel, G; Winkler, G.; Vonach, H. 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

In Progress report 1986 of Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.

5122 (INIS-mf—11037, pp 24) **Thermalization of electrons by simple molecular gases added to helium.** Caufield, K.; Cooper, R. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

5123 (INIS-mf—11037, pp 25) **Applications of microwave conductivity to fast processes in ionized gases.** Scales, M.; Cooper, R. (Melbourne Univ., Parkville, Australia. Dept. of Physical Chemistry). 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700431/JAW. (CONF-8611200—).

From 13. AINSE radiation chemistry conference; Lucas Heights, Australia (12 Nov 1986).

5124 **(Juel—2101) Medium energy neutron deep penetration experiment. Experimental and theoretical analysis.** Amian, W.; Cloth, P.; Druecke, V.; Filges, D.; Paul, N.; Schaal, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Nov 1986. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750161/JAW.

A deep penetration experiment conducted at the Los Alamos WNR facility's Spallation Neutron Target is compared with calculations using intra-nuclear-cascade and S/sub N/-transport codes in-

stalled at KFA-IRE. In the experiment medium energy reactions induced by neutrons between 15 MeV and about 150 MeV inside a quasi infinite slab of iron have been measured using copper foil monitors. Details of the experimental procedure and the theoretical methods are described. A comparison of absolute reaction rates for both experimentally and theoretically derived reactions is given. The present knowledge of the corresponding monitor reaction cross sections is discussed.

5125 **(LPNHE—85-02) CRAB or introduction of incertitudes on an example: the analysis of a radioactivity experiment.** Duboc, J.; Berard, J.M.; Burie, M.; Saison, A. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies). 1985. 53p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753235/JAW.

This software allows an approach of the experimental incertitude using the properties of Gauss distribution. It operates the statistical analysis of results from a radioactivity experiment made in a classroom.

5126 **(NRPB-R—204) Computation of Bremsstrahlung X-ray spectra over an energy range 15 keV to 300 keV.** Iles, W.J. (National Radiological Protection Board, Chilton (UK)). Mar 1987. 23p. H.M. Stationery Office, London, price Pound 4.00.

A method is described that enables bremsstrahlung X-ray spectra to be accurately predicted using a desk-top microcomputer without incurring excessive computation time. The theoretical model has been tested over an energy range 15 keV to 300 keV by comparison with experimentally measured spectra. Both lightly filtered and heavily filtered spectra produced by X-ray tubes of different target angle have been considered.

5127 **(RAL—87-028) Magnetic photon scattering.** Lovesey, S.W. (Rutherford Appleton Lab., Chilton (UK)). May 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750206/JAW.

The report reviews, at an introductory level, the theory of photon scattering from condensed matter. Magnetic scattering, which arises from first-order relativistic corrections to the Thomson scattering amplitude, is treated in detail and related to the corresponding interaction in the magnetic neutron diffraction amplitude.

5128 **Development of transmission positron moderators.** Gramsch, E.; Throwe, J.; Lynn, K.G. (Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **51**: No. 22, 1862-1864(30 Nov 1987). Contract AC02-76CH00016.

The conversion from fast to slow positrons by several thin (0.3—7 μm) film moderators has been studied. Positrons from a radioactive ^{22}Na source enter the film where some are thermalized, consequently diffuse to the surface opposite to the source and are emitted with low energies (1—4 eV). The experimental data show that the conversion efficiency to slow positrons ranges from 1 x 10^{-4} to 9.1 x 10^{-4} for good moderators. The moderator efficiency was found to be very sensitive to annealing temperatures.

5129 **Heavy ion beams in extended materials computational methods and experiment.** Wilson, J.W.; Schimmerling, W.; Wong, M.; Townsend, L. (NASA, Langley Research Center, Hampton, VA 23665). pp 442-450 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The transport of heavy ion beams in extended materials is a problem of interest in accelerator and space shielding, radiation therapy, and astrophysical and radiobiological studies. The beam particles change their energy and direction of motion through atomic/molecular collisions and undergo occasional radical transformation in nuclear collision. In health physics applications, a heavy ion beam of initially well defined radiation quality is transformed into a complex mixture of diverse quality components after passing through a modest amount of material. This transformation of radiation quality must be understood to adequately explain the biological response of tissue to heavy ion radiation. A theoretical/experimental program to define an ion beam and its products in extended matter is described.

6550 Medical Physics

REFER ALSO TO CITATION(S) 3128, 3165, 3427, 4519, 4539

5130 **(AERE-R—12731) UKAEA code of practice for tracer and irradiation studies involving the use of volunteers.** Pritchard, J.N.; Morgan, A. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jun 1987. 14p. H.M. Stationery Office, London, price Pound 4.00.

The subject is discussed under the following headings: 1) General considerations in volunteer studies (informed consent, beneficial objectives, recruitment from within or without the workforce, records, compensation, codes of practice, confidentiality etc.) 2) Tracer and irradiation studies approval committee, (terms of reference, membership, dose limitations, assessment of chemical toxicity, procedure for submitting proposals) 3) Obtaining a project licence 4) Conduct of volunteer experiments 5) The use of non-authority volunteers. (U.K.).

5131 **(BARC—1336) Development of a thermoluminescent personnel monitoring system.** (Bhabha Atomic Research Centre, Bombay (India)). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700302/JAW.

Thermoluminescent personnel monitoring system has been developed by the Division of Radiological Protection, Bhabha Atomic Research Centre (BARC), Bombay. The system is presently in use for estimation of personnel doses of radiation workers of BARC, other units of the Department of Atomic Energy, and Defence medical units in India. The report gives salient features of the TLD personnel monitoring system. The report discusses design considerations of thermoluminescent dosimetry (TLD) badge for measurement of X and β;, γ personnel exposures, a filter combination to compensate for energy dependence of the TLD disc and angular dependence of the badge. The badge reader incorporates a semiautomatic mechanical arrangement wherein the TLD cards are read, raising the heater after positioning the TLD discs one by one. Various figures illustrate the mechanical layouts and electronics circuits used in the system. Periodic quality assurance check of the system which ensures a good reproducibility, is also described. 17 figures, 5 tables, 7 refs.

5132 **(CNEA-NT—9/86) 2 π gaseous flux proportional detector.** Guevara, E.A.; Costello, E.D.; Di Carlo, R.O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Aplicaciones). 1986. 10p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700007/JAW.

A counting system has been developed in order to measure carbon-14 samples obtained in the course of a study of a plasmapheresis treatment for diabetic children. The system is based on the use of a 2π gaseous flux proportional detector especially designed for the stated purpose. The detector is described and experiment results are given, determining the characteristic parameters which set up the working conditions.

5133 **(CNEA-NT—14/86) Calibration of nuclides by gamma-gamma sum peak coincidence counting.** Guevara, E.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Aplicaciones). 1986. 127p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700009/JAW.

The feasibility of extending sum peak coincidence counting to the direct calibration of gamma-ray emitters having particular decay schemes was investigated, also checkings of the measurement accuracy, by comparing with more precise beta-gamma coincidence

counting have been performed. New theoretical studies and experiments were developed, demonstrating the reliability of the procedure. Uncertainties of less than one percent were obtained when certain radioactive sources were measured. The application of the procedure to /sup 60/Co, /sup 22/Na, /sup 47/Ca and /sup 148/Pm was studied. Theoretical bases of sum peak coincidence counting were set in order to extend it as an alternative method for absolute activity determination. In this respect, theoretical studies were performed for positive and negative beta decay, and electron capture, either accompanied or unaccompanied by coincident gamma rays. They include decay schemes containing up to three daughter nuclide excited levels, for different geometrical configurations. Equations are proposed for a possible generalization of the procedure. (M.E.L.).

5134 **(GSF—44/86) Applicability of radiological protection concepts to evaluating the environmental impact of chemicals.** Matthies, M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1986. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750182/JAW.

The report summarizes the principal concepts of radiological protection for investigating their applicability to evaluating the environmental hazard emanating from chemicals. It is shown that, especially with regard to the protection of the environment, application of these principles in general is not suitable, but some concepts can be applied and are explained to be the following: (1) Determination and application of conversion factors (equivalents) for chemicals and radiation in case of similarity of effects (mutagenic effect, sometimes carcinogenic effect). (2) Application of reference systems (e.g. reference man, reference ecosystems, sensitive species, critical populations) for assessment of exposure and effective potentials. (3) Models and methods for risk assessment and exposure limits (weighting of effects, optimisation requirement). (4) Hazard assessment by comparison with natural exposure and effects.

5135 **(INIS-mf—10724) Measurement and calculation of dose distribution behind airfilled hollow spaces in irradiation with fast electrons.** Stuhldreier, G. (Kiel Univ. (Germany, F.R.). Medizinische Fakultaet). 21 Mar 1983. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750155/JAW.

In the therapy of malignant tumours with fast electrons, it is important to measure and to calculate the shape and spatial extent of the dose distribution occurring behind airfilled hollow spaces, e.g. the sinuses. The effect of the size and depth of these hollow spaces on the changes of dose is found, in order to obtain estimated values for radiation therapy. The dose distribution of a needle beam was evaluated for the selected computer program, in order to take into account non-homogeneousness.

5136 (INIS-mf—11045, pp 189-200) **Health physics programs in low-level radioactive waste management at the Institute of Nuclear Energy Research, Republic of China.** Chen, W-L. Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

The primary mission of the health physics programs in low-level radioactive management is to ensure radiation safety for personnel and environment of the Institute of Nuclear Energy Research (INER), and also for the general public surrounding INER. In view of the above, the Health Physics programs in low-level radioactive waste management are divided into three sub-programs: the radiation control program, the environmental survey and bioassay program, and the radiation dosimetry supporting program. The general guidelines, responsibilities, and performance of these programs will be discussed in this paper in the following order. The responsibility of radiation control group is to conduct area monitoring and radiation surveillance for the radioactive waste treatment workers. It includes the control of radiation field level of the working area, servicing personnel dosimeters, instruction on radiation safety, and handling of radiation accidents. The responsibility of the environmental survey and bioassay group is to perform environmental surveys and bioassays. Environmental gamma monitoring stations were installed both on-site and off-site at INER. For bioassays, urine samples are taken from radioactive waste treatment workers, and for internal contamination checks of workers, total body counting systems are being used. The main responsibility of the radiation dosimetry group is to provide radiation dosimetrical support to the radiation control group and the environmental survey and bioassay group. Some typical work of the radiation dosimetry group is the qualitative assay and quantitative determination of radioactive samples, and calibration of dosimeters and survey meters.

5137 (INIS-mf—11045, pp 795-807) **Probability of intrusion events at radioactive waste disposal facilities.** Sandquist, G.M.; Rogers, V.C. (Utah Univ., Salt Lake City, USA; Rogers and Associates Engineering Corp., Salt Lake City, UT, USA). Dec 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700435/JAW. (CONF-860909—).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

A probabilistic model and data set are established to estimate radiation doses individuals might receive from radioactive low level waste (LLW) sites following cessation of surveillance and institutional control. The entire event space in which radiological events can transpire has dimensions in both space and time. The spatial distribution function is associated with the selection of land area sites for various uses (e.g., residencies, farms, grazing land, etc.). The temporal distribution function is associated with the time interval in which the event might occur. Although low level radioactive waste is stored in numerous locations throughout the world, focus is made upon the LLW sites at the Idaho National Engineering Laboratory (INEL) and the Savannah River Plant (SRP). The major land use fractions for principal pathways by which persons might be exposed to radiation for the LLW sites at INEL and SRP are determined. Data are given for the U.S., the appropriate agricultural regions and the states hosting these two sites and projections of land use fractions for the INEL and SRP sites if no LLW sites or institutional control existed. The probable occurence of at least one radiological exposure event is tabulated for cropland, pasture and residency at the INEL and SRP sites following loss of site control.

5138 (INIS-mf—11046, pp 54) **Determination of energy dependent parameters for the evaluation of absorbed neutron dose.** Binns, P.J.; Hough, J.H. (Council for Scientific and Industrial Research, Pretoria, South Africa. National Accelerator Centre). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

5139 (INIS-mf—11046, pp 55) **Dose distributions around I-125 seeds (Model 6702 and Model 6711).** Rae, W.I.D.; Shackleton, D. (Groote Schuur Hospital, Cape Town, South Africa). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700436/JAW. (CONF-8703200—).

From 27. annual congress of the South African Association of Physicists in Medicine and Biology; Bloemfontein, South Africa (11 Mar 1987).

5140 **(NRPB-R—202) Radiation doses to members of the public around AWRE, Aldermaston, ROF, Burghfield and AERE, Harwell.** Dionian, J.; Wan, S.L.; Wrixon, A.D. (National Radiological Protection Board, Chilton (UK)). Jul 1987. 62p. H.M. Stationery Office, London, price Pound 5.00.

All significant sources of radiation exposure are considered. (Natural radiation, fallout from nuclear weapons testing, medical procedures and reported atmospheric discharges). Discharges to the

Thames are also made from the three sites, but the water downstream of the discharge points is not used for drinking, although consideration is given to doses that might be received by a few hypothetical individuals from a number of possible exposure pathways resulting from these liquid discharges. The peak annual dose equivalents to the red bone marrow of 1-year-old children at 5 km from the sites are many orders of magnitude below that received from natural radiation. The factors are 34,000, 190,000,000 and 1,600 for AWRE, Aldermaston, ROF, Burghfield and AERE, Harwell, respectively. Similar factors apply to other population groups considered. Even at 0.5 km from the sites, the doses from the discharges are only a factor of about 20 higher than those at 5 km. The conclusion is that reported discharges make negligible contribution to total radiation doses received by the population living around the sites and are in no way responsible for increased incidence of leukaemia amongst children, if an increased incidence is shown to exist.

5141 **(NRPB-R—206) Conversion coefficients from air-kerma to ambient dose equivalent for the International Standards Organisation's wide, narrow and low series of reference filtered X-radiations.** Iles, W.J. (National Radiological Protection Board, Chilton (UK)). Mar 1987. 27p. H.M. Stationery Office, London, price Pound 4.00.

This report provides conversion coefficients from air-kerma to ambient dose equivalent for the International Standards Organisation's Wide, Narrow and Low Series of reference filtered X-radiations. The validity of the theoretical spectra used in the calculations is tested by detailed comparison with experimental results. Also, sensitivity analyses are performed to demonstrate the effect of tolerances in tube potential and filtration on the measured values of mean energy, first half-value layer and air-kerma rate. The theoretical spectral distributions of all members of the series are included within this report.

5142 **(PB—87-215828/XAB) Administration of the Radiation Control for Health and Safety Act of 1968, Public Law 90-602, April 1, 1987 (1986 annual report). Report for January-December 1986.** (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). 1 Apr 1987. 73p. (FDA/CDRH—87/49). NTIS, PC A04/MF A01.

See also report for 1985, PB—86-185683.

This report provides a summary of the operations of the Center for Devices and Radiological Health in carrying out that responsibility for calendar year 1986. Manufactureres of electronic products are required by 21 CFR 1002.20 to report accidental radiation occurrences to the CDRH. The Center no longer maintains a Radiation Incidents Registry, since accidental radiation occurrences are reported through the Device Experience Network (DEN) and through the requirements of the Medical Device Reporting (MDR) regulations.

5143 **(PNL—6301) Neutron dose and energy spectra measurements at Savannah River Plant.** Brackenbush, L.W.; Soldat, K.L.; Haggard, D.L.; Faust, L.G.; Tomeraasen, P.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000248/JAW.

Because some workers have a high potential for significant neutron exposure, the Savannah River Plant (SRP) contracted with Pacific Northwest Laboratory (PNL) to verify the accuracy of neutron dosimetry at the plant. Energy spectrum and neutron dose measurements were made at the SRP calibrations laboratory and at several other locations. The energy spectra measurements were made using multisphere or Bonner sphere spectrometers, ^{3}He spectrometers, and NE-213 liquid scintillator spectrometers. Neutron dose equivalent determinations were made using these instruments and others specifically designed to determine dose equivalent, such as the tissue equivalent proportional counter (TEPC). Survey instruments, such as the Eberline PNR-4, and the thermoluminescent dosimeter (TLD)-albedo and track etch dosimeters (TEDs) were also used. The TEPC, subjectively judged to provide the most accurate estimation of true dose equivalent, was used as the reference for comparison with other devices. 29 refs., 43 figs., 13 tabs.

5144 **(PNL—6303) Comparisons of uniform and discrete source distributions for use in bioassay laboratory performance testing.** Scherpelz, R.I.; MacLellan, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000246/JAW.

The Pacific Northwest Laboratory (PNL) is sending a torso phantom with radioactive material uniformly distributed in the lungs to in vivo bioassay laboratories for analysis. Although the radionuclides ultimately chosen for the studies had relatively long half-lives, future accreditation testing will require repeated tests with short half-life test nuclides. Computer modeling was used to simulate the major components of the phantom. Radiation transport calculations were then performed using the computer models to calculate dose rates either 15 cm from the chest or at its surface. For ^{144}Ce and ^{60}Co, three configurations were used for the lung comparison tests. Calculations show that, for most detector positions, a single plug containing ^{40}K located in the back of the heart provides a good approximation to a uniform distribution of ^{40}K. The approximation would lead, however, to a positive bias for the detector reading if the detector were located at the chest surface near the center. Loading the ^{40}K in a uniform layer inside the chest wall is not a good approximation of the uniform distribution in the lungs, because most of the radionuclides would be situated close to the detector location and the only shielding would be the thickness of the chest wall. The calculated dose rates for ^{60}Co and ^{144}Ce were similar at all calculated reference points. 3 refs., 5 figs., 10 tabs.

5145 **(UCRL—96447) The LLNL CR-39 personnel neutron dosimeter.** Hankins, D.E.; Homann, S.; Westermark, J. (Lawrence Livermore National Lab., CA (USA)). 29 Sep 1987. Contract W-7405-ENG-48. 16p. (CONF-871020—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000418/JAW.

From 6. symposium on neutron dosimetry; Neuherberg, F.R. Germany (12 Oct 1987).

We developed a personnel neutron dosimetry system based on the electrochemical etching of CR-39 plastic at elevated temperatures. The doses obtained using this dosimeter system are more accurate than those obtained using other dosimetry systems, especially when varied neutron spectra are encountered. This CR-39 dosimetry system does not have the severe energy dependence that exists with albedo neutron dosimeters or the fading and reading problems encountered with NTA film. 3 refs., 4 figs.

5146 **Wobbler facility for biomedical experiments.** Renner, T.R.; Chu, W.T. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Medical Physics;* **14**: No. 5, 825-834(Sep 1987). Contract AC03-76SF00098.

A system for spreading relativistic heavy ion beams into large uniform radiation fields has been developed. The charged particles passing through the system are deflected into azimuthally symmetric distributions which can then be superimposed to produce dose distributions as large as 30 cm in diameter with less than +- 3.5% variation in uniformity.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 3670, 4036, 4255, 4635, 5128, 5203

5147 **(AD-A—183626/1/XAB) Adsorption of H_2 and D_2 on Fe(110). 2. Angle resolved thermal-desorption spectroscopy and kinetic mechanism. Interim technical report.** Kurz, E.A.; Hudson, J.B. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 30 Jul 1987. 26p. (TR—3). NTIS, PC A03/MF A01.

See also 1, AD-A183 354.

Results of angle-resolved thermal desorption spectroscopy (ARTD) measurements for the adsorption of deuterium and hydrogen on iron are presented. A detailed model of the interaction process was developed using these results in combination with results obtained using thermal energy atom scattering (TEAS), reported in Part I of this work. Angle-Resolved-Thermal-Spectroscopy was

used to measure the desorption flux as a function of surface polar angle during temperature programming following adsorption at a low temperature. Second-order desorption kinetics, as observed with TEAS in part I, were confirmed. H_2 and D_2 were found to adsorb directly, dissociatively, and with an activation energy of 700 cal/mole. The sticking coefficient was observed to decrease with increasing coverage.

5148 **(CBPF-NF—011/87) Potts models and flows. III. Standard and subgraph break-collapse methods.** Magalhaes, A.C.N. de; Essam, J.W. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700306/JAW.

An algorithm is developed for the exact calculation of the many spin correlation functions of Potts model clusters which is more efficient than the standard break-collapse method traditionally used in real space renormalization group calculations. The improved performance is based on a relationship which, at any stage of the calculation, allows the replacement of certain subgraphs by single effective edges. Our method avoids, as in the standard one, the time consuming summation over spin states and can be very useful in series expansions and real space renormalisation group calculations on crystal lattices.

5149 **(CBPF-NF—014/87) Origin and orientation of electric field gradient in ordered FeNi.** Guenzburger, D.J.R.; Ellis, D.E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700307/JAW.

The electronic structure of tetrataenite, the ordered phase of Fe Ni, has been studied in the molecular cluster approximation using local density theory. Clusters containing 13 and 19 atoms were embedded in the fcc host lattice and spin-unrestricted potentials were iterated to self-consistency. Local moments, magnetic hyperfine fields and electric field gradients (EFG) at the iron sites were determined for comparison with experiment.

5150 **(CBPF-NF—015/87) Conversion electron Moessbauer spectroscopy study of RF sputtered Cd/sub 0.95/ Fe/sub 0.05/ Ie thin films.** Silva, E.G. da; Scorzelli, R.B.; Sanchez S, F.; Alvarez F, O.; Mendonza A, J.G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700308/JAW.

Conversion electron Moessbauer spectroscopy (CEMS) studies have been performed on Cd/sub 0.95/ Fe/sub 0.05/ Te films grown by r.f. sputtering on quartz and silicon substrates. The CEMS spectra show the presence of Fe/sup 2+/ and Fe/sup 3+/ in the films. The dependence of the population of both ions was studied as a function of substrate temperature, annealing temperature and substrate type.

5151 **(CBPF-NF—025/87) Short range order in vapor quenched amorphous Mn/sub x/ Sn/sub (sub 1-)x/ alloys using in situ /sup 119/ Sn Moessbauer spectroscopy.** Drago, V.; Saitovitch, E.M.B. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700309/JAW.

Th first sistematic in situ Sn/sup 119/, Moessbauer studies on vapor quenched amorphous Mn/sub x/ Sn/sub (sub 1-)x/ ($0.09 \leqq x \leqq 0.95$), are presented. A comparison of the values of the isomer shift and quadrupole splitting at different concentrations x with those of related MnSn intermetallic compounds suggests the existence of a crystalline likeshort range order in this amorphous system.

5152 **(CONF-8708160—1) Singularities in x-ray spectra of metals.** Mahan, G.D. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). Aug 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001440/JAW.

From Tsukuba Institute '87 on the Fermi Surface Effect; Tsukuba, Japan (1 Aug 1987).

The x-ray spectroscopies discussed are absorption, emission, and photoemission. The singularities show up in each of them in a different manner. In absorption and emission they show up as power law singularities at the threshholds frequencies. This review will emphasize two themes. First a simple model is proposed to describe this phenomena, which is now called the MND model after MAHAN-NOZIERES-DeDOMINICIS. Exact analytical solutions are now available for this model for the three spectroscopies discussed above. These analytical models can be evaluated numerically in a simple way. The second theme of this review is that great care must be used when comparing the theory to experiment. A number of factors influence the edge shapes in x-ray spectroscopy. The edge singularities play an important role, and are observed in many matals. Quantitative fits of the theory to experiment require the consideration of other factors. 51 refs.

5153 **(CTA-IEAV-RP—02/87) Interaction of intense electromagnetic fields with SF/sub 6/ molecules and clusters in supersonic expansion.** Airoldi, V.J.T. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Jan 1987. 169p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700310/JAW.

A method of measuring SF/sub 6/ cluster formation and inhibition in pulsed supersonic expansion in the presence of intense electromagnetic radiation is presented. The characterization of the expansion of SF/sub 6/ molecules was done and, the extension of the collision region was determined. An improved unidimensional theory of supersonic expansion showed good agreement with the experimental results. The spectra of multiphoton absorption of SF/sub 6/ molecules in supersonic jet and the average energy absorved by each molecule were determined. The absorption spectra of molecule in the collision region present absorption maxima different from those obtained in the collisionless region. The results, if compared with the literature data, show good agreement, with a small difference in the spetra corresponding to the collisionless region. This difference was observed, for the first time in the multiphoton absorption and is attribuited to cluster formation in the jet. A new technique for measuring cluster formation in the supersonic jet, based on determination of the spatial distribution of the energy of molecules in the jet after passing through a skimmer located in the collision region is shown. The inhibition of cluster formation, due to the incidence of intense electromagnetic radiation from a CO/sub 2/-TEA pulsed laser in the initial collision region of the jet, causes a second expansion in the skimmer. The results obtained show that this method can lead to a new isotope separation process. All the parts of the experimental set up, for example, high vacuum system, pulsed valve and pyroelectric detector, were developed and constructed specially for the experiment.

5154 **(DOE/ER/13632—1) Molecular dynamics studies of aromatic hydrocarbon liquids: Annual progress report, September 1, 1986-August 31, 1987.** McLaughlin, E.; Gupta, S. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemical Engineering). 1987. Contract FG05-86ER13632. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001473/JAW.

Algorithms for molecular dynamics simulations on supercomputers have been developed and simulations performed for fluids of nonspherical molecules modeled using the following potentials: two-center and three-center Lennard-Jones potentials in order to study phase-equilibria in these fluids, oblate and prolate Gaussian overlap potential (original and modified potentials), and dipolar and quadrupolar spheres. Simulation results have been used to test predictive methods: a nonspherical reference potential based thermodynamic perturbation theory and a sphericalized potential method. Both these methods work well for fluids modeled using the modified Gaussian overlap potential and the sphericalized potential method is, surprisingly, shown to work well for polar fluids also. Work is underway to model liquid benzene. 17 refs.

5155 **(DOE/ER/45131—5) Study of pattern formation at liquid interfaces: Progress report, November 1986-October 1987.** Maher, J.V. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Oct 1987. Contract FG02-84ER45131. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001399/JAW.

This paper summarizes the work done on the following topics at the University of Pittsburgh: the behavior of a tip-splitting, viscous-fingering system and the role of interfacial noise in pattern formation on planar interfaces; the search for instability on a quenched liquid interface; and binary liquid gels and polymer solutions. (LSP)

5156 **(DOE/ER/45222—05) [Atomic beam studies of the interaction of hydrogen with transition metal surfaces]: Technical progress report.** Batanouny, M.E. (Boston Univ., MA (USA)). 1987. Contract FG02-85ER45222. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000208/JAW.

This progress report discusses improvements in the helium scattering facility performance and using a spin-polarized metastable helium beam as a new probe of surface magnetism. (LSP)

5157 **(FRCEA-TH—36) Implantation of oxygen ions for the realization of SOS (silicon on insulator) structures: SIMOX.** Margail, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique; Institut National Polytechnique, 38 - Grenoble (France)). Mar 1987. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750267/JAW.

Highdose oxygen implantation is becoming a serious candidate for SOI (silicon on insulator) structure realization. The fabrication condition study of these substrates allowed to show up the implantation and annealing parameter importance for microstructure, and particularly for crystal quality of silicon films. It has been shown that the use of high temperature annealings leads to high quality substrates: monocrystal silicon film without any precipitate, at the card scale; Si/Si O/sub 2/ interface formation. After annealing at 1340/sup O/C, Hall mobilities have been measured in silicon film, and its residual doping is very low. First characteristics and performance of submicron CMOS circuits prooves the electric quality of these substrates.

5158 **(IAE—4236/11) Structure of radiation-induced damage of metals by high energy particle.** Turchin, S.I.; Zhuk, M.V.; Al'tovskij, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700338/JAW.

Analysis of the spatial structure of damage regions formed in metals by knocked-on atoms with the energy exceeding the threshold of purely coulomb collisions of atoms is carried out. The expression for probability of subcascade overlapping which is insignificant if the energy of the primary knocked-on atom exceeds the threshold of purely coulomb collisions (E/sub a/) is obtained. The damage caused by atoms with the energy higher than E/sub a/ can be reduced to the equivalent damage caused by atoms with the energy less than E/sub a/. Energy distribution of subcascades is analysed, the number of point defects produced there is calculated. 12 refs.; 4 figs.

5159 **(IAE—4239/11) Binding order model applied for the irradiated diamond.** Nikolaenko, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700339/JAW.

Carbon interatomic distance dependence on the binding order is given in the paper. Contributions into diamond lattice expansion from the interstitial atoms and to its compression from vacancies are evaluated. On the basis of this model the relation connecting irradiated diamong lattice expansion with concentration of Frenkel pairs is obtained. According to the same binding order model the values of the mean-square static atomic displacements and the stored energy of irradiated diamond saturated by point defects are calculated; effect of nitrogen impurities on the parameter of the diamong crystal lattice is also evaluated. The calculated values of these parameters are shown to agree with the experiment. 30 refs.; 5 figs.

5160 **(IAE—4240/11) Effect of point defects on graphite lattice parameters.** Nikolaenko, V.A.; Platonov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700340/JAW.

Contributions of interstitial atoms and vacancies into graphite lattice parameter change along c and a axes are calculated on the basis on the binding order model (dependence of the carbon interatomic distance on the binding order is used). The contribution into graphite lattice parameter change from the aggregate of interstitial atoms: binary, ternary and larger ones up to extraplanes, is determined on the basis of the same model. The $\Delta c/c : \Delta a/a$ ratio for irradiated graphite depending on the radiation and annealing temperature is analysed. Quantitatively calculated values of this ratio for the definite defects agree with the experiment. 23 refs.; 3 figs.

5161 **(IAE—4258/11) Sputtering of dielectric materials by nucleus fission fragments.** Katin, V.V.; Martynenko, Yu.V.; Yavlinskij, Yu.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700341/JAW.

A new theory of sputtering of dielectric materials by nucleus fission fragments is developed. The region of high-excitation electrons with temperature ~ 15-25 eV, 2-4 medium ionic charge and ~ 10 A initial radius is formed near the trajectory of fragment motion. Occurrence of the ionization wave causes the expansion of this region and cooling of the electron gas. Surface atoms of the hot region are turned out to be weakly bound with the lattice and at cooling they accumulate energy in the electric field of the double layer exceeding substantially their binding energy. The sputtering coefficient is ~ 10/sup 2/-10/sup 3/ atom/fragm. 8 refs.; 2 figs.

5162 (INIS-BR—874, pp 71) **Thermally stimulated currents in ZrO/sub 2/:MgO.** Muccillo, E.N.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, Brazil). 1987. (In Portuguese). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88700208/JAW. (CONF-8705175—Vol.1).

From 31. Brazilian congress on ceramics; Brasilia, DF, Brazil (24 May 1987).

Thermally Stimulated Depolarization Current measurements between 100 K and 350 K have been performed in ZrO/sub 2/:MgO ceramic samples to discriminate the several kinds of polarization (orientational and interfacial polarization, and extrinsic and intrinsic space charge effects) to allow for the use of the technique in the study of solid solution formation in partially stabilized zirconia. The samples were prepared by conventional ceramic processing methods. Different electrode materials have been used: colloidal graphite, silver, gold, and also insulating electrodes (e.g. mylar foils). The current spectra obtained are strongly dependent upon the electrode material showing the presence of spacial charge phenomenon in these ceramics.

5163 **(ISAS—40-87/CM) Electronic interband Raman scattering in direct III-V semiconductors: Non-local effects.** De Salvo, E.; Girlanda, R.; Quattropani, A. (International School of Advanced Studies, Trieste (Italy); Messina Univ. (Italy). Ist. di Struttura della Materia; Ecole Polytechnique Federale, Lausanne (Switzerland). Inst. de Physique Theorique). 1987. 8p. (CONF-8704190—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900062/JAW.

From 7. general conference of the condensed matter; Pisa, Italy (7 Apr 1987).

The interband Raman Scattering efficiency is evaluated within the effective mass approximation. The Hamiltonian describing the electronic states contains non-local potentials and therefore the interaction with the radiation field has to be modified in order to preserve the gauge independence of physical quantities. The result are compared to previous calculations, showing the importance of non-local corrections.

5164 (ISL-CO—216-86) Interaction of repetitively pulsed high energy laser radiation with matter. Hugenschmidt, M. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). Apr 1986. 11p. (CONF-8604210—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750479/JAW.

From 3. international symposium on optical and optoelectrical applied science and engineering; Innsbruck, Austria (14 Apr 1986).

The paper is concerned with laser target interaction processes involving new methods of improving the overall energy balance. As expected theoretically, this can be achieved with high repetition rate pulsed lasers even for initially highly reflecting materials, such as metals. Experiments were performed by using a pulsed CO/sub 2/ laser at mean powers up to 2 kW and repetition rates up to 100 Hz. The rates of temperature rise of aluminium for example were thereby increased by more than a factor of 3 as compared to cw-radiation of comparable power density. Similar improvements were found for the overall absorptivities that were increased by this method by more than an order of magnitude.

5165 (LBL—23976) Electronic band structure and photoemission: A review and projection. Falicov, L.M. (Lawrence Berkeley Lab., CA (USA); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Sep 1987. Contract AC03-76SF00098. 10p. (CONF-8709135—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002236/JAW.

From 14. international conference on X-ray and inner-shell processes; Paris, France (14 Sep 1987).

A brief review of electronic-structure calculations in solids, as a means of interpreting photoemission spectra, is presented. The calculations are, in general, of three types: ordinary one-electron-like band structures, which apply to bulk solids and are the basis of all other calculations; surface modified calculations, which take into account, self-consistently if at all possible, the presence of a vacuum-solid interface and of the electronic modifications caused thereby; and many-body calculations, which go beyond average-field approximations and consider dynamic rearrangement effects caused by electron-electron correlations during the photoemission process. 44 refs.

5166 (LYCEN—8609) Surface analysis by glow discharge spectrometry: cathode zone and sputtering yield. Ohannessian, L. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Jan 1986. 95p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750496/JAW.

Applications of the glow discharge optical spectroscopy for surface analysis are numerous. Moreover, this method enables to get qualitative and semi-quantitative results which are already significant. However, we should improve our knowledge of the physical parameters involved in the glow discharge lamp mechanisms and learn to handle such phenomena. The problems can be divided into two categories: sputtering of the target under argon ions accelerated in the cathode dark space, and luminous emission of torn away species which reach the negative glow region. Our aim was to take stock of the present theoretical knowledge which can be applied to the specific self-maintained glow discharge plasma. Moreover, we tried to link together (often roughly) the basic discharge parameters, i.e. current intensity I, voltage of the lamp Vg, pressure of the gas p. Specially a comparison between theoretical and experimental results was established concerning the pure target sputtering yields. The contribution of the argon ions striking the cathode is estimated taking into account their energetic distribution. The role of the fast argon neutrals produced by charge exchange with the ions is important; we evaluated their energetic distribution and their contribution to sputtering. The total theoretical sputtering yield is inferred: the comparison with experimental results is presented. The role of the gas temperature is emphasized.

5167 (LYCEN-TH—8644) Research of wake effects on the charge of dissociation fragments of fast molecular ions in a thin sheet. Ouaskit, S. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1986. 153p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750472/JAW.

When molecular ions are injected into a solid target the bonding electrons are removed and the atomic components propagate through the medium as clusters of correlated charged particles. Their propagation is influenced by the interaction of the ions with the medium, by their mutuel "Coulomb" repulsion and by the effects of the electronic wake trailing each ion. This wake can be described as follows: when a fas charged particle is moving faster than the Fermi velocity in a solid target, the target electrons tend to screen the ion charge and an oscillatory charge density, which is stationary in the projectile frame, trails the ion. The reality of this oscillatory behaviour has been already demonstrated in several experiments using molecular projectiles. We have done an experimental study where we tried to observe those oscillations by measuring the neutral hydrogen component emerging at O/sup 0/ when 100 keV/amu HeH/sup +/ and NH/sup +/ molecular ions are incident into thin carbon foils. We have not observed any effect related expected to the oscillations of the electronic density at the back surface of the foil. But we have observed significant over production of neutral hydrogen when the cluster is aligned with the beam direction. This suggests that the probability of electronic capture increases when the proton is aligned in the track of its heavy partner (N ou He).

5168 (PB—87-226411/XAB) Angle-resolved uv photoemission from Y(0001). Barrett, S.D.; Jordan, R.G. (Daresbury Lab. (UK)). Feb 1987. 12p. (DL/SCI/P—541E). NTIS, PC E03/MF E03.

A number of well-defined peaks were observed in the photoemission spectra from Y(0001) over the photon energy range 25 eV = or < h(nu) = or < 60 eV. The authors believe that one of the features with a binding energy of 1.7 eV is due to emission from states near the upper band edge at the Gamma point and that a second near E(F) originates from a surface state. A large peak was found at a binding energy of 9.6 eV which is sensitive to the quality of the surface.

5169 (PUC-TN—13/84) Electric dipole ordering in the alkali cyanides KCN and NaCN: short-range order effects. Davidovich, M.A.; Koiller, B.; Brandi, H.S.; Lutty, F. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). May 1984. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700068/JAW.

The low temperature phases of the alkali cyanides KCN and NaCN are investigated. The Ising Model with incorporation of pair correlations (Bethe approximation) is used to calculate the temperature dependence of the dielectric constant. The parameters of the model are obtained by adjusting its theoretical predictions to experimental values. This parametrization is used to calculate the temperature dependence of the specific heat. The results are in good agreement with experimental data.

5170 (RAL—87-029) Condensed matter and materials research using neutron diffraction and spectroscopy: reactor and pulsed neutron sources. Bisanti, P.; Lovesey, S.W. (Rutherford Appleton Lab., Chilton (UK)). May 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750208/JAW.

The paper provides a short, and partial view of the neutron scattering technique applied to condensed matter and materials research. Reactor and accelerator-based neutron spectrometers are discussed, together with examples of research projects that illustrate the puissance and modern applications of neutron scattering. Some examples are chosen to show the range of facilities available at the medium flux reactor operated by Casaccia ENEA, Roma and the advanced, pulsed spallation neutron source at the Rutherford Appleton Laboratory, Oxfordshire.

5171 (SAND—87-0975C) Shock compression of solids as a physical-chemical-mechanical process. Graham, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870753—78). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001674/JAW.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The changes introduced into solids while being processed through the abrupt stress and particle velocity transitions in the early portion of shock-compression pulses are not well described on a scientific basis, and their description presents perhaps the greatest challenge of modern shock-compression science. Over time scales from hundreds of picoseconds to hundreds of nanoseconds, solids are converted to states in which deformation is fluid-like to certain approximations. Descriptions of the transition regions have traditionally involved both physical and mechanical aspects. With recent studies of shock-induced solid state chemistry, the influence of chemical aspects must now be considered. Unfortunately, any change in chemical composition introduces substantial complications in analysis and interpretation of the shock-compression process. 40 refs., 3 figs.

5172 **Configurational energies and effective cluster interactions in substitutionally disordered binary alloys.** Gonis, A.; Zhang, X.h.; Freeman, A.J.; Turchi, P.; Stocks, G.M.; Nicholson, D.M. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 4630-4646(15 Sep 1987).

The determination of configurational energies in terms of effective cluster interactions in substitutionally disordered alloys from a knowledge of the alloy electronic structure is examined within the methods of concentration waves (CW) and the generalized perturbation method (GPM), and for the first time within the embedded-cluster method (ECM). It is shown that the ECM provides the exact summation to all orders of the effective cluster interaction expansions obtained in the partially renormalized GPM. The connection between the various methods (CW, GPM, and ECM) is discussed and illustrated by means of numerical calculations for model one-dimensional tight-binding (TB) systems and for TB Hamiltonians chosen to describe Pd-V alloys. These calculations, and the formal considerations presented in the body of the paper, show the complete equivalence of converged GPM summations within specific clusters and the ECM. In addition, it is shown that an exact expansion of the configurational energy can be obtained in terms of fully renormalized effective cluster interactions. In principle, these effective cluster interactions can be used in conjunction with statistical models to determine stable ordered structures at low temperatures and alloy phase diagrams.

5173 **Study of deposition conditions and hydrogen motion in r.f. sputtered hydrogenated amorphous silicon.** Albers, M.L. Ames, IA; Iowa State Univ. (1987). 156p. University Microfilms Order No. 87-16,735.Contract W-7405-ENG-82.

Thesis (Ph. D).

Three series of a-Si:H films were prepared by r.f. sputtering in He/H_2, Ar/H_2, and Xe/H_2 atmospheres. The r.f. power used for deposition was varied from 0.27 W/cm^2 to 3.3 W/cm^2 for each of these three series. The films were characterized using mechanical thickness, optical transmission, infrared, and electron spin resonance measurements. The deposition rates of these films were found to vary linearly with depositions rates predicted from known sputtering yields. The total hydrogen concentration of the films as a function of deposition rate was found to agree with the predictions of a kinematic model for hydrogen incorporation. The concentration of silicon atoms bonded to more than one hydrogen atom was found to agree with a random statistical model, although, there were fluctuations away from this model's predictions when high r.f. powers were used for deposition. The density of weak Si-Si bonds and the value of the Urbach edge coefficient were used to judge the quality of the films. It was found that samples prepared in an Ar/H_2 atmosphere at high r.f. powers (>2.2 W/cm^2) were of the highest quality. These experiments also indicated that silicon-hydrogen bonds in r.f. sputtered a-Si:H are stronger than silicon-hydrogen bonds in glow-discharge-produced a-Si:H.

6561 Superconductivity

REFER ALSO TO CITATION(S) 3721, 3725

5174 **(LA-UR—87-3307) Processing of superconductive materials and high frequency.** Smith, J.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 3p. (CONF-871167—1). NTIS, PC A02. Order Number DE88000481/JAW.

From 36. international wire and cable symposium; Arlington, VA, USA (17 Nov 1987).

We do not know yet if superconductivity will become useful without refrigeration. Now, the superconductors are so different from copper that it is difficult to imagine replacing copper with such a brittle material. Superconductors conduct dc with no loss, ac with small losses, and microwaves in co-axial lines with almost no loss and with no dispersion from dc to the highest frequencies. They will probably allow us to close the gap between radio frequency and infrared optical transmission. Clearly your industry should know some things about where superconductivity may lead us and must consider whether the greater risk is to develop them or to let others try it. There are no easy answers yet.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 3832, 4246, 4602, 4635, 4677, 4876, 4938, 4943, 5329, 5330, 5334, 5335

5175 **(CEA-CONF—8943) Refutation of an alternative to dark matter.** Jolicoeur, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Jan 1987. 5p. (CEA-SPhT—87-33; CONF-870164—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750083/JAW.

From 7. Moriond workshop: searches for new and exotic phenomena; Les Arcs, France (24 Jan 1987).

A modification of standard gravitational theory has been recently suggested by Sanders as a substitute for dark matter in order to explain the flatness of rotation curves of spiral galaxies. Cosmological consequences of this theory are investigated for a Robertson-Walker universe. There is a first period of expansion essentially described by General Relativity. Then in a second phase of Brans-Dicke type it recontracts until a very recent epoch. This is inconsistent with observational cosmology. 4 refs.

5176 **(CEA-CONF—8960) Quadratic analysis of linear transport equations.** Verwaerde, D. (CEA Centre d'Etudes de Vaujours, 77 - Courtry (France)). Feb 1987. 14p. (CONF-8702100—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752765/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

Performing transport computations on Lagrangian mesh is often difficult, because finite elements or finite differences methods are not directly implementable. One way to get ride of this is to formulate the problem in terms of even parity flux problem: The equation is then elliptic and a quadratic analysis is possible. We introduce here this analysis, use it to point out some properties and we perform a continuous finite element method in this formalism.

5177 **(CEA-N—2469) Deterministic particle method for the linearized Boltzmann equation.** Mas-Gallic, S. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Nov 1985. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753234/JAW.

We present a conservative particle method of approximation of integral operators which enables us to derive a numerical method of resolution of linear transport equations including integral terms. We prove the L/sup ∞/ convergence of the method at the order ϵ/sup 2/ + h/sup m//ϵ/sup m/ for any bounded time as soon as the cut-off belongs to W/sup m1/.

5178 **(CEA-N—2516) Transformation of an uniform plane shock into an uniform cylindrical or spherical shock.** Barbry, H.; Mounier, C.; Saillard, Y. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Dec 1986. 77p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753247/JAW.

We show a theoretical and numerical method for calculating the wall shape of a shock tube, which changes an initial plane shock of uniform strength into a cylindrical or spherical shock of uniform strength in some solid angle and without Mach reflections. This method uses Whitham's theory of shocks in characteristic form, and has been numerically developed to give the complete propagation of the shock through the convergent tube from its initial position to its final position. Some examples and numerical results are shown, and the dependence of the solution on the parameters is studied.

5179 **(CONF-871211—1) On the correlation free forms for nonlinear stochastic systems.** Meerkov, S.M.; Runolfsson, T.; Schuss, Z. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science; Tel Aviv Univ. (Israel). School of Mathematical Sciences). Dec 1987. Contract FG02-85ER13315. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011169/JAW.

From 26. IEEE CDC conference; Los Angeles, CA, USA (9 Dec 1987).

A method for analysis of nonlinear systems with wide-band and high-frequency stochastic parametric oscillations is developed and a correlation free description is obtained. Several illustrative examples are considered. 8 refs.

5180 **(DOE/ER/40200—119) Coherence, propagation and fluctuations of light: A generalized ray approach.** Simon, R.; Mukunda, N.; Sudarshan, E.C.G. (Texas Univ., Austin (USA). Center for Particle Theory; Institute of Mathematical Sciences, Madras (India); Indian Inst. of Science, Bangalore. Centre for Theoretical Studies). Oct 1987. Contract FG05-85ER40200. 70p. (CONF-8710182—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001669/JAW.

From Symposium on the coherence, propogation and fluctuations of light: the optical field; Rochester, NY, USA (24 Oct 1987).

Radiative transfer theory, wave optics and paraxial optics including Fourier optics can be treated uniformly and without any approximation in terms of generalized pencils of rays. This development is reviewed and the role of the groups SL(2,R), Sp(4,R) for paraxial propagation elaborated. The problem of polarization is studied with special care and correctly treated where explicit use of the Poincare group is made. Higher order correlations are taken up within the generalized pencil formalism, the differences between quantum and classical wave optics are highlighted. The effects of Bose quantization on ray-ray correlations is calculated and displayed. Many of these developments build on the work by Leonard and Emil Wolf and were inspired by their work. 81 refs.

5181 **(EFI—879-30-86) Critical behaviour of the infinite-dimensional Potts model.** Akheyan, A.Z.; Ananikyan, N.S. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700313/JAW.

The critical behaviour of the Q-component Potts model on Bethe lattice is studied. Critical temperatures T/sub c//sup (1)/ of the 2 order phase transition and T/sub c//sup (2)/, below which a spontaneous magnetization exists, are found. These temperatures coincide for the Ising model Q=2. Critical exponents β and δ, and also scaling function at T ~ T/sub c//sup (1)/ are calculated. The obtained critical exponents confirm the mean field results for the Ising model and are $\beta=1/2$, $\delta=3$, respectively. Their values are independent of Q. 5 refs.; 1 fig.

5182 **(EFI—880-31-86) Poyntings vector field lines of synchrotron radiation.** Arutyunyan, S.G.; Mailyan, M.R. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700314/JAW.

General equations for the Poynting vectos field lines of an arbitrary moving point charge are presented. The case of uniform circular motion is considered in detail and the transition to the uniform rectilinear motion is discussed. It is shown that unlike the uniform rectilinear motion, in case of synchrotron radiation the field lines of Pointing vectors do not form charge-containing closed surfaces. 7 refs.: 7 figs.

5183 **(EGG-SD—7822) Dynamical friction.** Lassahn, G.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002194/JAW.

A simple classical derivation of dynamical friction is given. The result allows expressing the friction term in terms of the velocity-space diffusion term in the Fokker-Planck equation. 8 refs.

5184 **(IFVE-OEF—86-90) Monte Carlo simulation of triangulated random surfaces in grand canonical ensemble.** Migdal, A.A.; Zmushko, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700378/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The model of triangulated random surfaces, corresponding to discretization of Polyakov string model is considered. An algorithm is proposed, which makes it possible to study the model in grand canonical ensemble by the Monte Carlo method. Preliminary results for the critical index γ are presented. 14 refs.; 4 figs.; 3 tabs.

5185 **(IFVE-OTF—85-13) Group of non-homogeneous point transformations in quantum mechanics and its generalization.** Budanov, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700386/JAW.

The transformation kernel and symbol of the interwining operator for the representation of the group of non-homogeneous point canonical transformations have been found in the Weyl symbol space of quantum operators. It was shown in what form the singularity symbols and group characters are associated with the singularities and stationary points of differential mapping. The Green functions linear momentum hamiltonians is also found. The method of canonical P-L transformation is suggested. 16 refs.

5186 (INIS-mf—11041, pp 625-636) **Abelian monopole fermion system as a non-Abelian limit.** Farhi, E. (Massachusetts Inst. of Tech., Cambridge, USA. Lab. for Nuclear Science). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

The quantum mechanics problem of a single charged fermion moving in the presence of a point like Dirac monopole is discussed. (M.F.W.).

5187 (INIS-mf—11041, pp 61-72) **Supergravity and antigravitation.** Morel, B.; Richard, J. (Geneva Univ., Switzerland. Inst. de Physique Theorique). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

We explore the phenomenological constraints on the existence of a spin 1 antigravitation, and its consequences for supergravity.

5188 (INIS-mf—11041, pp 87-89) **Running couplings in guts.** Vecsernyes, P. (Roland Eoetvoes Univ., Budapest, Hungary. Inst. for Theoretical Physics). 1983. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88700434/JAW. (CONF-8305119—).

From 4. Warsaw symposium of elementary particles; Kazimierz, Poland (30 May 1983).

It is shown how to do the more accurate calculation of the mass of the superheavy bosons and of the weak mixing angle in every possible gut. (M.F.W.).

5189 **(LA—11113-MS) Eigenvalues and eigenvectors of field tensors and associated energy tensors.** Turner, A.W. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001951/JAW.

The properties of symmetric and antisymmetric matrices are examined, and the existing theorems of Synge are applied to five example cases. It is found that Synge's theorems require some restatement to be generally valid. Specifically, some of Synge's theorems only apply to second-rank, four-dimensional, antisymmetric tensors having six real and six imaginary components. In addition, distinctions must be made in some of Synge's theorems between general eigenvectors and eigenvectors of the form (a_1,a_2,a_3,ia_4), where the a/sub k/ are real numbers. Properties of the five example tensors are summarized, and properly restricted versions of Synge's theorems are given in the concluding section of the report. 3 refs.

5190 **(NBI-HE—87-37) Path integral to quantize spin.** Nielsen, H.B.; Rohrlich, D. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750194/JAW.

We present a model for a classical spinning particle, characterized by spin magnitude, arbitrary but fixed, and continuously varying direction. A gauge freedom of the model reflects the choice of canonical coordinates in the phase space, which is spherical. We formulate the path integral for the model and find, unexpectedly, that the phase space must be punctured at the poles. It then follows that both the total spin and spin projection along any axis are quantized. The model has rotational invariance and yields the usual quantum mechanics of spin, including commutation relations, in a simple way.

5191 **(NBI-TH—11/87) Classical adiabatic holonomy.** Gozzi, E.; Thacker, W.D. (Niels Bohr Inst., Copenhagen (Denmark); Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). 1987. 14p. (MPI-PAE/PTh—20/87; CONF-870280—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750192/JAW.

From Workshop on skyrmions and anomalies; Krakow, Poland (20 Feb 1987).

We briefly review the classical-adiabatic-holonomy effect known as Hannay's angle. We find, with purely classical methods, that the angle two-form connected with this phenomenon can be associated with a modification of the slow variable dynamics. We point out, all along, the analogies with the Berry-phase effect and, in particular, we study the Hannay-angles for the classical Grassmannian system associated to a quantum spin in magnetic field.

5192 **(NORDITA—87/31-P-S-Prepr.) Statistical mechanics of surfaces with curvature dependent action.** Jonsson, T. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1987. 9p. (CONF-8706211—1-Prepr.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750197/JAW.

From Workshop on statistical physics; Lyngby, Denmark (9 Jun 1987).

We review recent results about discretized random surfaces whose action (energy) depends on the extrinsic curvature. The surface tension scales to zero at an appropriate critical point if the coupling constant of the curvature term is taken to infinity. At this critical point one expects to be able to construct a continuum theory of smooth surfaces.

5193 **(SAND—87-1859C) Tutorial on elementary bifurcation theory.** Romero, L.A. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 10p. (CONF-871207—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014849/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

This paper presents elementary results on bifurcations of equilibrium and periodic solutions. When solving equations of motion equilibrium conditions of second order systems, two stable regimes can be found. The point at which the two solutions intersect is called a bifurcation point. Bifurcation theory is concerned with multiple solutions to nonlinear equations and how these solutions appear, disappear, and intersect as equation parameters are changed. 11 refs., 13 figs.

5194 **(UCRL—15960) Advanced numerical modeling of microwave penetration and coupling for complex structures: Final report, January 1985 to June 1987.** Taflove, A.; Umashankar, K.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science; Illinois Univ., Chicago (USA). Communications Lab.; Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001873/JAW.

This research program has established a systematic numerical approach to model electromagnetic wave coupling phenomena related to slot apertures and wire bundles associated with complex, cavity-type structures. VAX-type software providing computational examples of the numerical methods is available. Efficient Cray-type software (providing enhanced user friendliness) is under development.

5195 **(UWThPh—1987-15) Free energy and the dynamical entropy of space translation.** Narnhofer, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700071/JAW.

The dynamical entropy is used in the variational principle of thermodynamics. It is shown that for lattice systems and short range interactions the corresponding equilibrium states (= tangent planes to the free energy) are the KMS-states. Therefore the free energy obtained in this way coincides with the usual one.

5196 **(UWThPh—1987-25) Supersymmetric generalization of von Neumann's theorem.** Grosse, H.; Pittner, L. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700080/JAW.

We first give a formulation of supersymmetric quantum mechanics and define superunitary and generalized canonical transformations acting in a modul. Next we assume that there are operators which give an irreducible representation of the canonical commutation and anticommutation relations, respectively, and prove that two such representations are connected by a uniquely determined superunitary transformation, under suitable domain assumptions. This extends the well-known uniqueness theorem of von Neumann to canonical (anti-) commutation relations using anticommuting parameters.

5197 **(UWThPh—1987-26) Peculiar relation between mass and energy with respect to the Schroedinger equation.** Flamm, D.; Schoeberl, F.; Uematsu, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700081/JAW.

Considering energy eigenvalues E(m/sub 1/, m/sub 2/) with respect to two particles whose mass is m/sub 1/, m/sub 2/ respectively, one would expect that if M>m then E(M, m/sub 2/)>E(m, m/sub 2/), but actually the opposite can happen if one solves the Schroedinger equation. In other words derivative $\delta E/\delta m$/sub 1/ can be negative. In this paper a general condition of this problem is given.

5198 **Delocalization and correlation effects in atomic systems: Solution of the Hubbard model for general spin.** Whaley, K.B.; Falicov, L.M. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 12, 7160-7170(15 Dec 1987).

The effects of quantum statistics and atomic correlations on motion in two-dimensional periodic potentials is studied within a Hubbard model for both Bose—Einstein and Fermi—Dirac statistics. Exact eigenstates are obtained for finite clusters with periodic

boundary conditions, and the extent of ground state delocalization evaluated for both statistics.

5199 **Response to "Comment on 'Bell's theorem and the foundation of quantum physics' " [Am. J. Phys. 55, 1142 (1987)].** Stapp, H.P. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* 55: No. 12, 1143-1144(Dec 1987).

The principle of EPR locality is discussed. (AIP) e

5200 **Weight-2 zeros of 3j coefficients and the Pell equation.** Louck, J.D.; Stein, P.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* 28: No. 12, 2812-2823(Dec 1987). Contract W-7405-ENG-36.

All weight-2 zeros of the Wigner 3j coefficients may be obtained from the quadratic Diophantine equation known as Pell's equation. These zeros may then be classified by the orbits of a discrete, infinite-order subgroup of the Lorentz group SO(1,1). This is carried out by transforming the "polynomial part" of a weight-2 3j coefficient to Pellian form and obtaining the fundamental zeros numerically. The relation of this polynomial to a family of binary quadratic forms is also given, together with a discussion of the invariance group.

5201 **Bistability driven by weakly colored Gaussian noise: The Fokker-Planck boundary layer and mean first-passage times.** Doering, C.R.; Hagan, P.S.; Levermore, C.D. (Center for Nonlinear Studies and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* 59: No. 19, 2129-2132(9 Nov 1987). Contract W-7405-ENG-36;W-7405-ENG-48.

We develop a singular perturbation approach to the problem of first-passage times for non-Markovian processes driven by Gaussian colored noise near the white-noise limit. In particular we treat the problem of overdamped tunneling in a bistable quartic potential in the presence of Gaussian noise of short correlation time tau. The correct treatment of the absorbing boundary yields a lowest-order correction proportional to tau/sup 1/2/ with a proportionality constant involving the Milne extrapolation length for the Fokker-Planck equation, given in terms of the Riemann zeta function.

5202 **Improved method for studying tunneling and false vacuum decay.** Haymaker, R.W.; Matsuki, T.; Wang, S.; Cooper, F. (Louisiana State Univ.). pp 353 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors present a self-consistent method for determining tunneling rates through a barrier for cases in which quantum effects contribute to the shape of the potential. They question the use of the effective potential which is a static quantity in a dynamical tunneling problem as for example in the New Inflationary Universe scenario. Their method treats the two effects consistently. They present tunneling rate examples for a quantum mechanical system and for a four dimensional field theory. The latter is needed for the calculation of false vacuum decay.

5203 **Three dimensional Q.E.D. and the fractional quantum Hall effect.** Johnson, K. (Center for Theoretical Physics, Massachusetts Institute for Technology, Cambridge, MA 02139). pp 343-345 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The anomalous vacuum expectation of the current density in three dimensional quantum electrodynamics is derived in a general form. Its relationship to the fractional quantum Hall current for non-relativistic electrons is provided.

5204 **Real time tunneling in field theory.** Cooper, F. (Los Alamos National Lab.). pp 353 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author discusses two strategies for studying tunneling processes in field theory in real time in Minkowski space. The first method is the finite element approach for solving the Heisenberg equations. The second method is a Langevin equation simulation of tunneling in Minkowski space.

5205 **A new approach to the low energy effective action expansion.** Chan, L.H. (Louisiana State Univ.). pp 353 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author presents a general and natural method for evaluating the low energy effective action expansion. The higher derivative terms beyond the effective potential can be evaluated in a direct and practical manner. As an illustration of the power of this new method, he has applied it to the self-coupled scalar field in the one-loop approximation up to terms containing four derivatives. Other possible applications are also discussed.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 4671

7001 Plasma Research

REFER ALSO TO CITATION(S) 4104, 4223, 4638, 4653, 5281, 5282, 5296, 5296

5206 **(CNEA-NT—21/86) Experimental study of the initial plasma formation stage in a linear theta pinch of inverted field.** Casin, G.C.; Alvarez, R.; Rojkind, R.H.; Rodrigo, A.B. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Prospectiva y Estudios Especiales). 1986. 87p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700010/JAW.

The initial stage of the plasma formation was studied in a linear theta pinch. Experiments were made to determine the machine operating conditions for good shot-to-shot reproducibility. Spectroscopic measurements of electron density and of electron and ion temperature were made afterwards to characterize the plasma at different stages of its heating process. The results obtained indicate that shot-to-shot reproducibility is strongly influenced by the presence of impurities and by the plasma preionization technique used. Under proper operating conditions, excellent reproducibility was observed. The measured values of the plasma parameters are compatible with those determined for similar machines.

5207 **(CONF-8709142—3-Vugraphs) Subcommittee for MHD theory: Status report.** Dory, R.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000596/JAW.

From Ignition physics study group meeting; San Diego, CA, USA (21 Sep 1987).

This progress report contains viewgraphs on the limits of the beta value and the safety factor for tokamak magnetohydrodynamic flows. (LSP)

5208 **(DOE/ER/53172—3) The TFTR alpha extraction and measurement project: Final report.** Gerdin, G.A. (Illinois Univ., Urbana (USA)). 20 Sep 1987. Contract FG02-84ER53172. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000953/JAW.

This paper discusses research performed between January 1984 and July 1987; it concerned the following areas relevant to alpha particle diagnostics: charge neutralization of alphas by foils, charged fusion product test facility, and modeling the atomic interactions between the alphas and the ablation cloud of a refueling pellet. 9 refs.

5209 **(EUR-CEA-FC—1315) X crystal spectrometry on plasma. Measurements on Asdex experiment.** Reisse, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Dec 1986. 60p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750490/JAW.

Study of line spectra emitted by impurities in the soft X ray field is used as a characteristic measurement of plasma. Besides the transport classical measurements and the line Doppler broadening study, modification of spectra emitted by plasma with a population of non-thermal electrons; a simple model allowed an evaluation of their density using the helium-like iron and titanium ions.

5210 **(EUR-CEA-FC—1317) HE11 radiation patterns and Gaussian approximations.** Rebuffi, L.; Crenn, J.P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Dec 1986. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750489/JAW.

The possibility of approximating the HE11 radiation pattern with a Gaussian distribution is presented. A numerical comparison between HE11 far-field theoretical patterns and Abrams and Crenn approximations permits an evaluation of the validity of these two approximations. A new numerically optimized HE11 Gaussian approximation for the far-field, extended to great part of the near field, has been found. In particular, the value given for the beam radius at the waist, has been demonstrated to give the best HE11 Gaussian approximation in the far-field. The Crenn approximation is found to be very close to this optimal approximation, while the Abrams approximation is shown to be less precise. Universal curves for intensity, amplitude and power distribution are given for the HE11 radiated mode. These results are of interest for laser waveguide applications and for plasma ECRH transmission systems.

5211 **(EUR-CEA-FC—1318) Experimental and theoretical characteristics for guided propagation and radiation of TE11 and HE11 modes.** Rebuffi, L. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Nov 1986. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750491/JAW.

In this work, the main characteristics of the TE11 and HE11 modes have been theoretically computed and experimentally verified. An interesting effect of interference in the near field pattern, greater in TE11 and smaller in HE11, has been detected. This pattern modification could lead to important non linear effects in the absorption of the microwave power by the plasma. A comparison between these almost linearly polarized modes permits a careful choice of the launching beam for ECRH experiments of a plasma.

5212 **(EUR-CEA-FC—1319) Angular distribution of the total cyclotron radiation of a relativistic particle with parallel velocity.** Johner, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jan 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750492/JAW.

A closed form formula is given for the mean power radiated per solid angle in a given direction by a relativistic particle in cyclotronic motion with a non zero parallel velocity. The difference between emitted and received mean power for a non closed periodic motion is illustrated in this case.

5213 **(EUR-CEA-FC—1320) Optimized monomial approximations with integer exponents of the deuterium-tritium thermonuclear reaction rate.** Johner, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Feb 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750254/JAW.

Monomial approximations of the thermonuclear deuterium-tritium reaction rate (σ v)/sub DT/ = α /sub /n T/sup n/ are proposed for $5 \geqq n \geqq 0$ with the corresponding validity limits on T. Appropriate choice of the validity limits on T. Appropriate choice of the validity interval and optimization of α/sub n/ permit a reduction of the mean error of this representation to less than 3% between 1.4 and 100 KeV.

5214 **(EUR-CEA-FC—1321) Pellet injection experiments on the TFR Tokamak.** (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Feb 1987. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750469/JAW.

Single pellet injection experiments have been carried out on TFR with the aim to improve the experimental knowledge of ablation physical processes and also to get a better description of the heat and matter transport during and after pellet evaporation. Ablation clouds have been photographed, providing experimental penetration depths in rough agreement with the neutral shielding model. Observation of striations in the cloud has led to an experimental determination of the safety factor profile. Parameters of the plasma in the ablation cloud have been spectroscopically determined. Fast heat transport has been evidenced during pellet evaporation (— 100 μs) which exhibits some features of minor or major disruptions (appearance of a m = 1, n = 1 island on the q = 1 surface, bursts of density fluctuations, comparable heat diffusivity, ...). Matter transport takes place on a larger time scale (— 10 ms). This long temporal relaxation is well accounted for by the 1D-MAKOKOT computer code without changing the transport coefficients after pellet injection. Heat and matter transport are affected by the presence of the m = 1, n = 1 island on the q = 1 surface.

5215 **(EUR-CEA-FC—1323) On the spectra of highly-ionized krypton, strontium, zirconium and rhodium excited in the plasma of the TFR tokamak.** Wyart, J.F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Feb 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750494/JAW.

Strontium, zirconium and rhodium have been injected into TFR tokamak plasmas by using the laser blow-off technique, and their spectra recorded either photographically (Zr, 10-92 A) or photoelectrically (all three elements, 10-330 A). Line identifications for several isoelectronic sequences from sodium -like to gallium-like are reported. Additionally, isoelectronic regularities observed for these three elements have allowed to identify a few krypton lines left unidentified in our previous work.

5216 **(EUR-CEA-FC—1324) Simple formula for the bremsstrahlung emissivity of fusion plasmas.** Johner, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Apr 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750470/JAW.

The asymptotic expansion of the exact nonrelativistic electron-ion bremsstrahlung emissivity for temperatures much larger than the Rydberg energy is derived. The ascending series expansion of the Born relativistic electron-ion emissivity for temperatures much lower than the electron rest mass energy is also obtained. It is shown that the two results combine to give the electron-ion emissivity for temperatures of interest in fusion plasmas. Adding the Born nonrelativistic electron-electron emissivity, we obtain a simple formula which describes the total bremsstrahlung emissivity with a precision better than 1% between T/sub e/ = 0.7 keV and T/sub e/ = 25 keV (for Z = 1).

5217 (EUR-CEA-FC—1325) Comments on density fluctuations and confinement in Tokamak. Olivain, J.; Andreoletti, J.; Gervais, F.; Quemeneur, A.; Gresillon, D.; Truc, A.; Barkley, H. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Apr 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750471/JAW.

Anomalous transport imposes a serious limitation on Tokamak performance. Here, one possible cause of the transport "anomaly" is commented, the low frequency turbulence observed through density fluctuations. Recent progress gained on this issue are analysed.

5218 (FRNC-TH—2663) Study of mixed radiative thermal mass transfer in the case of spherical liquide particle evaporation in a high temperature thermal air plasma. Garandeau, S. (Poitiers Univ., 86 (France)). 1984. 149p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750108/JAW.

Radiative transfer in a semi-transparent non-isothermal medium with spherical configuration has been studied. Limit conditions have been detailed, among which the semi-transparent inner sphere case is a new case. Enthalpy and matter transfer equations related to these different cases have been established. An adimensional study of local conservation laws allowed to reveal a parameter set characteristic of radiation coupled phenomena thermal conduction, convection, diffusion. Transfer equations in the case of evaporation of a liquid spherical particle in an air thermal plasma have been simplified. An analytical solution for matter transfer is proposed. Numerical solution of radiative problems and matter transfer has been realized.

5219 (FRNC-TH—2927) Theory and experimental show up of axial magnetic fields self-generated in dense laser-produced plasmas. El Tamer, M. (Toulouse-3 Univ., 31 (France)). Sep 1986. 185p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750233/JAW.

The work presented in this thesis concerns the magnetic fields generated in laser produced plasma. A summary of the theoretical and experimental studies concerning the toroidal magnetic fields and realised by different groups of research is presented. Then, we present our original contribution on the generation of axial magnetic fields by the dynamo effect. The experimental work for the detection of magnetic field is based on the Faraday rotation and Zeeman effects. The experimental diagrams are detailed and discussed. The experimental results are presented and compared to the theory. Finaly, we present some consequences of the generation of the axial magnetic fields in laser produced plasma as a discussion of the thermal conductivity.

5220 (IAE—4206/12) Muon stripping probability at processes of dμ-atom deceleration and excitation in substance. Men'shikov, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700336/JAW.

It is shown that in the deceleration process of (μHe)/sup +/, formed during the muon-catalyzed fusion reactions dtμ -> μ/sup 4/He+n and ddμ -> μ/sup 3/He+n, a considerable part of muons is stripped in the collisions of μHe with deuterium and tritium nuclei and, as a result of this, the sticking probability of muons to helium decreases by about 30%. 9 refs.

5221 (IAE—4235/6) Self-sustained oscillations in the divertor plasma. Krasheninnikov, S.I.; Kukushkin, A.S.; Pistunovich, V.I.; Pozharov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700337/JAW.

A simple analytical model of the edge plasma with high recycling, which relays on the presence of a small parameter - the ratio of the particle flows crossing the magnetic field to those impinging onto the divertor target, is proposed. A concept of the one-dimensional steady state (OSS) is introduced as the zero approximation in the small parameter. The mean number density N-tilde of the particles - ions plus neutrals - in the magnetic flux tube is choosen as the most representative and convenient parameter of the problem. The OSS are shown to be ambiguous in some N-tilde range for sufficiently high values of the energy flow entering the scrape-off layer from the bulk plasma. An equation, that describes a quasi-steady variations in OSS, is derived and a mechanism of exciting the self-sustained oscillations is developed. Results of simulation of the edge plasma oscillations are found to be in a good agreement with this mechanism, which could be responsible for the H-mode oscillations observed in the divertor experiments. 23 refs.; 10 figs.

5222 (IAE—4297/7) Method of plasma diagnostics by a heavy ion beam for the T-15 tokamak. Krupnik, L.I.; Mel'nikov, A.V.; Nedzel'skij, I.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700342/JAW.

Possibilities of using method of plasma diagnostics by heavy ion beams for measurement of plasma parameters the T-15 tokamak were discussed. Basic parameters of probing beams were determind, various schemes of the experiment were suggested, the description of the necessary measurement equipment was given. The method is based on accelerated ion beam injection into a plasma in the plane perpendicular to the direction of confining magnetic fiel. The diagnostic complex of plasma probing by heavy particle beams comprises heavy particle injector, detector unit with energy analyzer, the control system and the system for storage and processing of obtained experimental results. It is shown that time-of-flight method for determination of probing particle energy is the most promissing one for large facilities. 32 refs.; 12 figs.

5223 (IAE—4304/6) Current generation and induced conductivity of a plasma under common action of constant electric field and lower-hybrid or ECR waves. Dnestrovskij, Yu.N.; Kostomarov, D.P.; Parail, V.V.; Smirnov, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700345/JAW.

Analytical and numerical study was made on the effect of curl electric field on the efficiency of current generation by lower-hybrid and ECR-waves. The expression for induced plasma conductivity σ/sub 1/ due to the group of epithermal electrons formed under the effect of high-frequency waves was obtained. Analytical formula for σ/sub 1/ was derived for the low level high-frequency feed energy; for high power σ/sub 1/ was determined on the base of numerical solution of two-dimensional kinetic equation. 5 refs.; 2 figs.

5224 (IAE—4327/7) Simulation an experiment on plasma instability investigation in a tokamak with a divertor. Gasilov, N.A.; Gerasimov, S.N.; Zotov, I.V.; Sychugov, D.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700352/JAW.

Results of calculating equilibrium of elongated plasma filament with two-zero and single-zero divertors are presented. Effect of external current location and vertical displacement of current channel center on separatrix splitting was analyzed. The data on properties of stabilizing systems composed of a random number of descrete ring conductors were obtained. Various conductor systems providing plasma stability under the assumption of their ideal conductivity were suggested for plasma filament with parameters of T-12 tokamak. Increments of plasma instability occurring due to terminal conductivity of stabilizing elements were calculated. 16 refs.; 13 figs.; 4 tabs.

5225 **(IAE—4330/7) Model for plasma equilibrium configuration evolution in a tokamak with adiabatic compression.** Zhogolev, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700354/JAW.

The problem statement of calculation of a series of plasma equilibrium configuration in the T-14, T-15 tokamaks related by conditions of flux frozen - in and the adiabatic law of pressure variation is given. The equations for the description of the internal equilibrium of a plasma which have a simpler form than for the electrodynamic momenta method and contain adiabatic couplings are obtained. The model suggested is convenient for construction of and algorithm aimed at calculation of parameter evoluation of a plasma with a free boundary during compression by an external field. The method for its realization is discussed and results of test calculations are given. 6 refs.; 4 figs.

5226 **(IAE—4333/7) Tokamak with highly elongated cross-section of a plasma.** Brevnov, N.N.; Gribov, Yu.V.; Zhogolev, V.E.; Pogutse, I.O.; Putvinskij, S.V.; Strizhanova, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700356/JAW.

Problems related to the formation and control of the equilibrium of the filament with a highly elongated cross section $K \leq 4$, where K is the relation of semiaxes, are considered. Calculations of equilibrium, stability and evolution of plasma parameters are performed to develop poloidal field systems and choice of the optimal scenario of the discharge. A round filament is supposed to form at the initial stage, and then to elongate its cross section up to $K=4$ due to the operation of the poloidal field system. The results of calculation of plasma equilibrium are given; currents in poloidal coils necessary to provide series of equilibria with subsequent increasing elongation of the cross section are found. Stability of the highly elongated filament is discussed; the position of windings of passive stabilization is calculated. The results of calculation of evolution of plasma parameter profiles in the process of formation of the elongated cross section. The calculations allow to chose the proper period of this process. The following conclusions are made: to provide the filament equilibrium with cross section elongation up to $K=4$, the poloidal field system should be supplied with additional windings; the total current in these windings is to be not less than 100 kA i.e. ~ 40% of the plasma current; the poloidal field system is to be supplied with the automatic control system. 7 refs.; 8 figs.

5227 **(IAE—4341/7) Experimental dependencies of tau/sub E/ on n, q and R in the T-13 tokamak.** Belashov, V.I.; Bortnikov, A.V.; Brevnov, N.N.; Gerasimov, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700358/JAW.

Consideration is being given to results of experimental investigation at the T-13 tokamak of dependence of confinement time in electron tau/sub E/ component on plasma density safety factor, discharge current, large radius R. It is shown in the region of tau/sub E/ linear dependence on density that conditions exist under which tau/sub E/n/ value (where n - plasma density) doesn't depend on large radius as well as condition under which tau/sub E/n/ depends on large radius tau/sub E/n/ ~ R/sup γ/ where $\gamma \geq 2$. This condition corresponds with tau/sub E/n/ maximal value for the given experiments. 18 refs.; 13 figs.

5228 **(INIS-mf—10983) Non-equilibrium in flowing atmospheric plasmas.** Haas, J.C.M. de. (Technische Univ. Eindhoven (Netherlands)). 30 Sep 1986. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700039/JAW.

This thesis deals with the fundamental aspects of two different plasmas applied in technological processes. The first one is the cesium seeded argon plasma in a closed cycle Magnetohydrodynamic (MHD) generator, the second is the thermal argon plasma in a cascade arc with an imposed flow. In Chapter 2 the influence of non-equilibrium on the mass and energy balances of a plasma is worked out. The general theory presented there can be applied to both the plasma in an MHD generator and to the cascade arc with imposed flow. Introductions to these plasmas are given in the Chapters 3 and 6 respectively. These chapters are both followed by two chapters which treat the theoretical and the experimental investigations. The results are summarized in Chapter 9. (Auth.). Includes Dutch summary

5229 **(IPP—1/240) Investigations and tests for the double crystal monochromators KS1 and KS2 for JET.** Fink, J.; Morsi, H.W.; Roehr, H.; Schumacher, U. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1987. 42p. (IPP-JET—33). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750436/JAW.

For the design and construction of the two double crystal monochromators built for JET, the 'active phase' (system KS1) and the 'spatial scan' (system KS2) double crystal devices, several tests of important components had to be performed. Results are given for the tests of suitable crystals, the measurements of the dispersion and resolution of the swivelled double crystal device, the tests of the collimators, and the development of the large-area X-ray source, which was applied for the KS2 X-ray tests.

5230 **(IPP—2/282) Ion cyclotron instabilities driven by the nearly perpendicular neutral beam injection in the Wendelstein VII-A stellarator.** Maassberg, H.; Hellberg, M.A. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1986. 89p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750434/JAW.

The problem of ion cyclotron instabilities driven by the high power neutral beam injection is investigated for the conditions of the W VII-A stellarator by means of linear stability analysis. On the basis of only collisional (classical) slowing down, beam ion distribution functions are calculated by means of Monte Carlo simulation. In this report, various cases are considered: Transient beam ion distributions (i) immediately after switch on the neutral beam injection and (ii) after half of an average slowing down time; stationary beam ion distributions (iii) for confinement properties strongly improved by radial electric fields, transport and fast orbit losses are neglected for these situations, and (iv) for worse confinement properties for which the average beam ion confinement time is of the order of the average slowing down time. Furthermore, the distribution functions of the ions originating from the neutral beam injection are estimated for the early phase of the discharges with low temperatures and for the later phase with maximum ion temperatures.

5231 **(IPP—4/232) Comparison of the calculated neutral beam shinethrough of the Wendelstein VII-A injection with calorimetric measurements.** Penningsfeld, F.P. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750441/JAW.

Density profiles of the Wendelstein VII-A plasma as measured by Thomson scattering are used to calculate the temporally and spatially varying power density of the neutral beam shinethrough on the torus calorimeter for several shot series. The total energy deposited by the three beam species is obtained by integrating the transmitted power density in space and time. This global quantity is compared with the calorimetric measurements routinely performed for each shot. The agreement between calculated and measured energy is found to be $\Delta E/E = 2.3 +- 11\%$ confirming the error estimation for the NEUDEN program used, which was only slightly modified to calculate the power density transmitted in the target plane. From this good agreement it is concluded that the program contains a realistic beam model and reliable cross-sections for the beam attenuation which is important for further applications. Furthermore, the same comparison was done with old results of the ODIN code by analyzing the corresponding raw data as far as they could be recovered, obtaining a similarly good consistency. A possible increase of 10 to 20% of the beam stopping cross section which could be expected for Wendelstein VII-A conditions by the effect of multistep collision processes as suggested by Boley et al. is discussed also.

5232 **(IPP—5/14) Consequences of nonlinear heat transport laws on expected plasma profiles.** Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750432/JAW.

The expected variation of plasma pressure profiles against changes in power deposition is investigated by using a simple linear heat transport law as well as a quadratic one. Applying the quadratic transport law it can be shown that the stiffening of the resulting profiles is sufficient to understand the experimentally measured phenomenon of 'profile consistence' without further assumptions of nonlocal effects.

5233 **(IPP—5/15) Theory of Bernstein waves coupling with loop antennas.** Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750433/JAW.

We present a fully three-dimensional theory of antenna coupling to Ion Bernstein Waves near the first harmonic of the ion cyclotron resonance in tokamak plasmas. The boundary conditions in vacuum are solved analytically for arbitrary orientation of the antenna and Faraday screen conductors. The wave equations in the plasma, which include Finite Larmor Radius and finite electron inertia effects, cyclotron and harmonic damping by the ions, and Landau and collisional damping by the electrons, are solved numerically using a Finite Elements discretisation with cubic Hermite interpolating functions. Applications to Alcator C give reasonably good agreement between the calculated and measured radiation resistance in the range in which efficient heating is observed; outside this range the calculated resistance is lower than the experimental one. In general, the coupling efficiency is found to be very sensitive to the edge plasma density, good coupling requiring a low density plasma layer in the vicinity of the Faraday screen. Coupling also improves with increasing scrape-off ion temperature, and is appreciably better for antisymmetric than for symmetric toroidal current distributions in the antenna.

5234 **(IPP—III/119) Laser-blow-off experiments on ASDEX.** Setzensack, C. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1987. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750439/JAW.

In 1985 laser blow-off system was installed on the ASDEX tokamak and in the following period a number of experiments were performed. The idea of these investigations was to study the impurity behaviour under different plasma conditions. New and unexpected results were obtained: 1. Considerable improvement of the impurity confinement time in OH plasmas near to the density limit, 2. influence on ELMs by impurities, 3. strong dependence of the impurity confinement time on the gradient of the plasma current, and 4. different impurity confinement under various heating conditions.

5235 **(JET-R—87-02) Energy confinement in JET ohmically heated plasmas: June 1983-December 1985.** Cordey, J.G. (comp.). (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Feb 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750219/JAW.

The report concerns the energy confinement properties of ohmically heated JET discharges, from a local and a global point of view. A description is given of the plasma characteristics, and the range of conditions explored by JET since the start of the experiment. The plasma resistivity is examined, and it is shown that the resistivity is close to neoclassical. The global energy confinement properties are evaluated, and comparisons are made between the JET data and data from other experiments. The local energy confinement properties, and the electron thermal conductivity from heat pulse propagation, are both discussed. (U.K.).

5236 **(JET-R—87-03) Calibration methods for ECE systems with microwave sources. A feasibility study.** Tubbing, B.J.D.; Kissel, S.E. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750645/JAW.

The authors investigated the feasibility of two methods for calibration of electron cyclotron emission (ECE) systems, both based on the use of a microwave source. In the first method -called the Antenna Pattern Integration (API) method - the microwave source is scanned in space, so as to simulate a large - area - blackbody -source. In the second method -called the Untuned Cavity (UC) method -an untuned cavity, fed by the microwave source, is used to simulate a blackbody. For both methods, the hardware required to perform partly automated calibrations was developed. The microwave based methods were compared with a large area blackbody calibration on two different ECE systems, a Michelson interferometer and a grating polychromator. The API method was found to be more successful than the UC method.

5237 **(LA-UR—87-3042) A review of the experimental and theoretical status of the reversed-field pinch.** Baker, D.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 25p. (CONF-870836—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000529/JAW.

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

This paper reviews the status of the reversed-field pinch (RFP) approach to the development of a compact nuclear fusion reactor. Two RFP papers in this conference are complementary; the first paper contains the historical origins and basic concepts concerning MHD instabilities, relaxation and RFP confinement properties as well as a discussion of future prospects of the RFP. This paper gives an overview of the status of plasma parameters of the present main RFP experiments and of the status of theory and experiment of the interesting RFP plasma phenomena of relaxation, self reversal and flux generation (these effects are often referred to as the dynamo effect). The low frequency oscillating-field current drive concept which exploits these effects is discussed. Particular emphasis is given to the theoretical results obtained from plasma simulation codes used in these active areas of study. Selected topics of recent research on the Los Alamos ZT-40M experiments are reported. The paper concludes with descriptions of the next generation Los Alamos RFP experiment ZTH, to be located in the new Confinement Physics Research Facility (CPRF) presently under construction, and the characteristics of an RFP compact reactor. 68 refs.

5238 **(LA-UR—87-3326) Numerical models for high beta magnetohydrodynamic flow.** Brackbill, J.U. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 42p. (CONF-8706154—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001850/JAW.

From IEEE minicourse on computer applications in plasma science; Arlington, VA, USA (3 Jun 1987).

The fundamentals of numerical magnetohydrodynamics for highly conducting, high-beta plasmas are outlined. The discussions emphasize the physical properties of the flow, and how elementary concepts in numerical analysis can be applied to the construction of finite difference approximations that capture these features. The linear and nonlinear stability of explicit and implicit differencing in time is examined, the origin and effect of numerical diffusion in the calculation of convective transport is described, and a technique for maintaining solenoidality in the magnetic field is developed. Many of the points are illustrated by numerical examples. The techniques described are applicable to the time-dependent, high-beta flows normally encountered in magnetically confined plasmas, plasma switches, and space and astrophysical plasmas. 40 refs.

5239 **(MATT—950) Effect of magnetic shear on convective plasma transport.** Okuda, Hideo; Dawson, J.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1973. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001987/JAW.

The effect of magnetic shear on convective plasma transport is investigated both by analytic theory and by computer simulations. It is found that the convective diffusion coefficient increases linearly with the shear length until it saturates at the value for closed field lines, after this it is constant. It is essentially independent of B for ω/sub pi/ > ω/sub ci. 15 refs.

5240 **(ORNL/TM—10574) Transport scaling in the collisionless-detrapping regime in stellarators.** Crume, E.C. Jr.; Shaing, K.C.; Hirshman, S.P.; van Rij, W.I. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001511/JAW.

Stellarator transport scalings with electric field, geometry, and collision frequency in the reactor-relevant collisionless-detrapping regime are determined from numerical solutions of the drift kinetic equation. A new geometrical scaling, proportional to ϵ/sub t/ sup 3/2/ rather than ϵ/sub t/ϵ/sub h/sup 1/2/, is found, where ϵ/ sub t/ is the inverse aspect ratio and ϵ/sub h/ is the helical ripple. With the new scaling, no reduction in energy confinement time is associated with large helical ripple, which provides design flexibility. Integral expressions for the particle and heat fluxes that are useful for transport simulations are given. 11 refs.

5241 **(PPPL—2461) Course/workshop on muon catalyzed fusion and fusion with polarized nuclei.** Kulsrud, R.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1987. Contract AC02-76CH03073. 28p. (CONF-870448—Summ.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000114/JAW.

From Workshop on muon-catalyzed fusion and fusion with polarized nuclei; Erice, Italy (3 Apr 1987).

There seems to be some real connection between the spin states of the d-t nuclei in the muon mesomolecule dtμ and the resultant sticking probability. This paper discusses this connection. No new experimental results on spin polarization are reported, but illuminating ideas emerged as to the role spin polarized plasmas could play in inertial confinement fusion and magnetic fusion. In addition, realistic evaluations were made as to the possibility of producing and preserving spin polarized plasmas. 4 refs.

5242 **(SAIC—87/1826) Slowing down tail enhanced, neoclassical and classical alpha particle fluxes in tokamak reactors.** Catto, P.J.; Tessarotto, M. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.; Trieste Univ. (Italy). Facolta de Scienze). Oct 1987. Contract AC03-76ET53057. 25p. (PRI—116). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001930/JAW.

The classical and neoclassical particle and energy fluxes associated with a slowing down tail, alpha particle distribution function are evaluated for arbitrary aspect ratio, cross section, and poloidal magnetic field. The retention of both electron and ion drag and pitch angle scattering by the background ions dramatically increases the radial losses. The enhanced neoclassical losses will preclude ignition unless tokamak reactors are designed with a substantially smaller alpha banana width than previously believed necessary. 14 refs.

5243 **(SNC/TD—8511) Survey of the potential of plasma technology application in Canada. Final report.** (SNC Group, Montreal, Quebec (Canada). Technical Development Dept.). Nov 1985. 138p. (MICROLOG—86-04147). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This study comprises an assessment of the potential of plasma technology application in several Canadian industrial sectors and processes, including iron and steel production, conversion of hydrocarbons to chemical and synthetic fuels, melting-remelting operations, production of refractory metals and alloys, and synthesis of extra-pure, equiaxed, fine particles for production of advanced (engineering) ceramics. The study is limited to currently available plasma technology and processes that have been demonstrated either commercially or on a pilot-plant level, or during extensive laboratory investigations. A brief description of the currently available plasma technology (generators, reactors, processes, and systems) is given to allow comparison with corresponding conventional or competing processes, where applicable. Technical assessment of the potential of this plasma technology application in Canada and R&D strategy to support the technology commercialization are presented. Also, where possible, an attempt has been made to include some preliminary economic considerations. 45 tabs., 51 figs.

5244 **(UCID—21171) Measuring GAMMA 10 end-loss ions with an ELIS [end-loss-ion spectrometers] from TMX-U.** Foote, J.H. (Lawrence Livermore National Lab., CA (USA)). 3 Sep 1987. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001927/JAW.

The author spent the period from March 22 to July 10, 1987, at the GAMMA 10 tandem-mirror experiment at the University of Tsukuba in Tsukuba, Japan. The purpose of this extended trip was to install on GAMMA 10 one of the end-loss-ion spectrometers (ELIS) used on TMX-U (Tandem Mirror Experiment-Upgrade) at LLNL and to make plasma measurements there with this diagnostic instrument. This report discusses the considerable planning and preparations that preceded the trip, the actual experience with the ELIS equipment at GAMMA 10, data and results obtained while the author was there, GAMMA 10 experimental procedures, the scientific and technical support during the stay, and some final comments and suggestions concerning an international exchange such as this one. The data acquired on GAMMA 10 while there, along with earlier data, present an encouraging picture of a plasma in a thermal-barrier mode in a tandem-mirror, magnetic-fusion machine. 6 refs.

5245 **(UCRL—96720) Microwave superheaters for fusion.** Campbell, R.B.; Hoffman, M.A.; Logan, B.G. (TRW, Inc., Redondo Beach, CA (USA); California Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—27). NTIS, PC A02. Order Number DE88001656/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The microwave superheater uses the synchrotron radiation from a thermonuclear plasma to heat gas seeded with an alkali metal to temperatures far above the temperature of material walls. It can improve the efficiency of the Compact Fusion Advanced Rankine (CFAR) cycle described elsewhere in these proceedings. For a proof-of-principle experiment using helium, calculations show that a gas superheat ΔT of 2000°K is possible when the wall temperature is maintained at 1000°K. The concept can be scaled to reactor grade systems. Because of the need for synchrotron radiation, the microwave superheater is best suited for use with plasmas burning an advanced fuel such as D-^{3}He. 5 refs.

5246 **Asymmetric double Langmuir probe: Small signal application.** Uckan, T. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **58**: No. 12, 2260-2263(Dec 1987). Contract AC05-84OR21400.

We discuss the asymmetric double Langmuir probe (ADLP) and demonstrate the possibility of using it to measure plasma temperature T/sub e/ and density n when it is operated in the region of small signal response. The area of one of the ADLP collectors is considerably larger than the other. This probe can be operated at a relatively low applied voltage eV/sub a//T/sub e/<1, and still provides sufficient information to determine the plasma T/sub e/ and n. There is no need for a direct measurement of the ion saturation current, which can be on the order of a few amperes in large fusion devices. This reduces the requirements on the probe power supply.

5247 **Measuring the escaping beam ions from a tokamak plasma.** Buchenauer, D.; Heidbrink, W.W.; Roquemore, L.; McGuire, K. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 12, 2264-2270(Dec 1987).

A new technique using a silicon surface barrier (SSB) diode has been developed for measuring the escaping fast ion flux from a tokamak plasma. Calibration of the detector with an ion beam showed that at a fixed energy the diode's output current varied linearly with the incident deuteron flux. The diode was mounted inside the PDX vacuum vessel with collimating apertures designed to admit the spiraling orbits of 50-keV deuterons expelled from the plasma by MHD instabilities. Results from PDX indicated that relative measurements of the escaping fast ion flux due to several plasma instabilities could be made.

5248 **Plasma current sustained by fusion charged particles in a field-reversed configuration.** Berk, H.L.; Momota, H.; Tajima, T. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 11, 3548-3565(Nov 1987).

The distribution of energetic charged particles generated by thermonuclear fusion reactions in a field-reversed configuration (FRC) are studied analytically and numerically. A fraction of the charged fusion products escapes directly while the others are trapped to form a directed particle flow parallel to the plasma current. It is shown that the resultant current density produced by these fusion charged particles can be comparable to background plasma current density that produces the original field-reversed configuration in a D—^{3}He reactor. Self-consistent equilibria arising from the currents of the background plasma and proton fusion products are constructed where the Larmor radius of the fusion product is of arbitrary size. Reactor relevant parameters are examined, such as how the fusion reactivity rate varies as a result of supporting the pressure associated with the fusion products. A model for synchrotron emission from various pressure profiles is developed and it is shown quantitatively how synchrotron losses vary with different pressure profiles in a FRC.

5249 **Field-reversed configuration profiles and resistivities inferred from the radial line-integral density profile.** Chrien, R.E.; Okada, S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 11, 3574-3578(Nov 1987).

The beta and magnetic field profiles of field-reversed configurations (FRC's) can be inferred from the radial profile of the line-integral density together with a temperature model. When these profiles are combined with the particle and flux decay times, the plasma resistivities at the field null and separatrix can also be deduced. This method is applied to a class of FRC's formed in the FRX-C/LSM device [in Proceedings of the Seventh US—Japan Workshop on Compact Toroid Research, 1985 (Spectra Technology, Inc., Bellevue, WA, 1985), p. 33; in Plasma Physics and Controlled Nuclear Fusion Research, 1986 (IAEA, Vienna, 1986), Vol. 2, p. 673].

5250 **Numerical determination of the magnetic field line Hamiltonian.** Kuo-Petravic, G.; Boozer, A.H. (Plasma Physics Laboratory, Princeton University, P.O. Box 541, Princeton, New Jersey 08544). *Journal of Computational Physics;* **73**: No. 1, 107-124(Nov 1987).

The structure of a magnetic field is determined by a one-degree-of-freedom, time-dependent Hamiltonian. This Hamiltonian is evaluated for a given field in a perturbed action-angle form. The location and the size of magnetic islands in the given field are determined from Hamiltonian perturbation theory and from an ordinary Poincare plot of the field line trajectories. copyright 1987 Academic Press, Inc.

5251 **Orthogonal grid construction for modeling of transport in tokamaks.** Petravic, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Computational Physics;* **73**: No. 1, 125-130(Nov 1987).

A simple method has been developed for numerically constructing orthogonal grids based on the tokamak poloidal flux surfaces. The poloidal flux surfaces form a natural set of coordinate lines for the study of transport in the tokamak scrape-off region, since the energy transport there is mostly along the field lines contained within the flux surfaces. For a study of both the poloidal and perpendicular (radial) transport, a two-dimensional, preferably orthogonal, mesh is required. The need for a new mesh generating code arose from the requirements of the particular topology produced by the zeros in the poloidal field (x-points) and the consequent problems with the numbering of the mesh. copyright 1987 Academic Press, Inc.

5252 **Solution of hot particle ballooning mode integral equation in Tokamaks.** Stotler, D.P.; Berk, H.L. (Institute for Fusion Studies, The University of Texas, Austin, Texas 78712). *Journal of Computational Physics;* **73**: No. 1, 5-40(Nov 1987).

The solution for the stability of ballooning mode equations in tokamaks with hot particles is presented. The system for equations requires solving a combined set of differential and integral equations accounting for the detailed hot particle orbits. Special techniques are developed to describe the equilibrium, the linear set of matrix equations, and the boundary conditions. A modified WKB technique is developed to treat the boundary conditions. A detailed discussion is given of how boundary conditions are determined. We rigorously show why, in some cases, the eigenfunction may be exponentially growing with an outgoing group velocity. Sample results are presented. copyright 1987 Academic Press, Inc.

5253 **Observation of an induced-scattering instability driven by static field asymmetries in a pure electron plasma.** Eggleston, D.L.; Malmberg, J.H. (University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **59**: No. 15, 1675-1678(12 Oct 1987).

We show experimentally that the presence of static field asymmetries can affect the stability of a confined pure electron plasma. A new induced-scattering instability is observed whose threshold and growth rate depend on the amplitude of static field asymmetries. The presence of the instability is associated with a twelvefold enhancement of radial plasma transport. The qualitative features of this instability are found to be in agreement with recent theoretical work.

5254 **Stability of the low-frequency hot-electron interchange mode for a bumpy torus simulation model.** Ohsawa, Y.; Dawson, J.M.; Van Dam, J.W. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **30**: No. 10, 3237-3244(Oct 1987).

The parametric dependence of the growth rate of the low-frequency hot-electron interchange mode is studied with a two-and-a-half-dimensional relativistic electromagnetic particle code that models the geometry of a bumpy torus. The simulation results are compared in detail with finite-Larmor-radius theory, as well as zero-Larmor-radius theory. For the long-wavelength modes, the growth rates measured in the simulations tend to agree with those predicted from zero-Larmor-radius theory. For short-wavelength modes, the stabilizing effects of finite Larmor radius are significant.

5255 **Proposed neutral-beam diagnostics for fast confined alpha particles in a burning plasma.** Schlachter, A.S.; Cooper, W.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 727-738(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Diagnostic methods for fast confined alpha particles are essential for a burning plasma experiment. Several methods which use energetic neutral beams have been proposed. We review these methods and discuss considerations for their implementation.

5256 **Lasers for open structures.** Bigio, I.J.; Kurnit, N.A.; Harrison, R.F.; Shimada, T. (Los Alamos National Laboratory, MS-J566, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **156**: No. 1, 137-144(5 May 1987). (CONF-8608123—).

From Advanced accelerator concepts conference; Madison, WI, USA (21 Aug 1986).

Laser-driven accelerator schemes place unique demands on the specifications of the invoked laser systems. We review the laser

requirements for driving open microstructures. The specific advantages and disadvantages that lasers bring to this scheme are listed, and the appropriateness and scalability of existing technology is discussed. Finally we review the plans and status for the laser activities of the Brookhaven/Los Alamos collaboration on a proof-of-principle experiment.

5257 **Particle simulations of ion rings for magnetic fusion.** Lyster, P.M. Ithaca, NY; Cornell Univ. (1987). 325p. University Microfilms Order No. 87-08,874.

Thesis (Ph. D.).

This thesis contains a numerical study of the dynamics of axis encircling charged particles in ion rings and layers. Part of this work deals with the coalescence of ion rings to form field reversed rings, which may be useful for Compact Torus magnetic fusion reactors. The coalescence of weak ion rings with Compact Toroids is also investigated. This is important because a component of energetic particles may help to maintain the flux or stabilize these configurations against a number of macroscopic magnetohydrodynamic instabilities. Several different types of particle codes are used. RINGA and CIDER are two and one half-dimensional codes in cylindrical axisymmetric geometry. A theoretical and computational study is made of a mechanism by which ring translational energy is transferred to Alfven waves in a conductive plasma. A new collective phenomenon is discussed whereby the merging of rings is improved if they have stronger initial self fields. A study is made of the coalescence of strong field-reversed ion rings in highly conductive plasmas, in which it is found that magnetic field line reconnection is an important process. Finally, a study of the magnetic compression of ion layers in conductive plasmas is presented.

5258 **Applications of radio-frequency power to plasmas.** Bernabei, S.; Motley, R.W. (eds.). New York, NY; American Institute of Physics (1987). 494p. (CONF-870570—). American Institute of Physics, 335 East 45th St., New York, NY 10017 $62.00. Order Number TI88001387/JAW. Contract AC02-76CH03073.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

This book contains papers on radio-frequency heating of plasmas. The general categories of these papers are as follows: electron cyclotron range of frequencies; lower hybrid range of frequencies; ion cyclotron range of frequencies; alfven waves; and general theory of rf waves and non-fusion applications of rf power. Separate abstracts have been prepared for the individual papers in these proceedings. (LSP)

5259 **On the possibility of achieving a condensed crystalline state in cooled particle beams.** Schiffer, J.P.; Rahman, A. (Argonne National Laboratory, Argonne, IL 60439). *AIP (American Institute of Physics) Conference Proceedings;* **150**: No. 1, 354-356(15 Oct 1986). (CONF-860575—). Contract W-31-109-ENG-38.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Calculations have shown that when a plasma of one kind of particle (one-component plasma or OCP) is below a certain temperature, it will undergo a phase transition and the particles will form a crystalline (bcc) array.[1] The relevant parameter is $\Gamma(q^2/a)/kT$ (where a is the average spacing and the T the temperature) and the transition takes place at $\Gamma = 170$. The properties of proposed storage rings for heavy ions with $q>>e$, are such that an ordered array may actually be realized.

5260 **Electrostatic-mode coupling of beat-excited electron plasma waves.** Darrow, C.B. Los Angeles, CA; Univ. of California (1986). 146p. University Microfilms Order No. 87-11,681.

Thesis (Ph. D).

The nature of the spectrum of electrostatic waves excited when two laser beams beat in a plasma containing a density ripple is investigated theoretically, experimentally, and computationally. A theoretical model for the beat-wave-excitation process in a rippled-density plasma is developed. The model predicts the generation of a rich spectrum of plasma modes with frequencies equal to the beat frequency of the two laser beams and wave numbers equal to integer multiples of the ripple wavenumber. For commonly encountered experimental parameters, a new beat-wave saturation mechanism was found that can limit the amplitude of the beat wave to a value below that expected for the widely quoted relativistic detuning process. The effects of stimulated Raman scattering, ion wave harmonics, and other coupling mechanisms are also discussed. CO_2 laser experiments designed to study and characterize beat-wave excitation and mode coupling were conducted. Results of collective ruby laser Thomson scattering and other measurements of the electrostatic and scattered electromagnetic spectra are presented. Despite the richness in physics of the experiment, the simple model is able to predict the observed behavior and characteristics of the beat wave and coupled modes.

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REFER ALSO TO CITATION(S) 3444, 3673, 4065, 4066

5261 **(CEA-R—5383) Conversion frequence.** Sauteret, C. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Mar 1987. 122p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750270/JAW.

The experimental evidence of short wavelength for laser inertial confinement has strongly increased the interest in high efficiency harmonic conversion of powerful Nd: glass lasers. This work describes our high power harmonic conversion experiments performed using the same laser apparatus for doubling, tripling the three high power 1064 nm P102, OCTAL and PHEBUS lasers. In addition to the understanding the physics of harmonic conversion, this work includes the basic concepts allows us to improve the technique such as non colinear schemes, to extend this method to other frequencies (fourth generation) and to predict some physical limits.

5262 **(CONF-871007—16) Design of a repeating pneumatic pellet injector for the Joint European Torus.** Milora, S.L.; Combs, S.K.; Baylor, L.R.; Sparks, D.O.; Foust, C.R.; Gethers, F.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001414/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A three-barrel pneumatic pellet injector has been developed for plasma fueling of the Joint European Torus (JET). The versatile device consists of three independent machine-gun-like mechanisms that operate at cryogenic temperatures (14°K to 20°K). Individual high speed extruders provide a continuous supply of solid deuterium to each gun assembly, where a reciprocating breech-side cutting mechanism forms and chambers cylindrical pellets from the extrusion; deuterium pellets are then accelerated in the gun barrels with controlled amounts of compressed hydrogen gas (pressures up to 100 bars) to velocities $\leqq$ 1.5 km/s. The injector features three nominal pellet sizes (2.7 mm, 4.0 mm, and 6.0 mm) and has been tested at repetition rates of 5 Hz, 2.5 Hz, and 1 Hz, respectively. Each gun is capable of operating (individually or simultaneously) at the design repetition rate for 15-second duration pulses (limited only by the capacity of the extruder feed system). A remote, stand-alone control and data acquisition system is used for injector operation. 7 refs.

5263 **(CONF-871125—5) Vacuum vessel heating system for ATF [Advanced Toroidal Facility].** Langley, R.A.; Neilson, G.H.; Alban, A.M.; Slaughter, E.; Sumner, J.N.; White, J.A. (Oak Ridge National Lab., TN (USA); Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000570/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

An 80-kW system for heating the Advanced Toroidal Facility (ATF) stainless steel vacuum vessel to 150°C, the design limit of the vessel, has been designed. The system's primary purpose is to accelerate the outgassing of the vessel walls during the initial pumpdown following an opening to atmospheric pressure. It will also measure the thermal time constant of the vessel. These meas-

urements are important for assessing the vessel's power-handling capability. The main body of the vessel is induction heated by applying 440-V, 60-Hz power directly to the main torsatron windings. The eddy currents that this power induces in the vessel produce an estimated 50 kW of Joule heating. The vacuum vessel temperature is measured with an array of thermocouples. A programmable logic controller regulates the temperature and provides interlock and overheating protection. A system of 60 heating tapes, each rated at 520 W, is installed on the ports and ducts attached to the vessel. This system, in conjunction with the induction heating systems, is planned to provide temperature uniformity. The total heating power and rates of rise and fall of the vessel temperature have been calculated using a model of the vacuum vessel. The results are given.

5264 **(CONF-8708138—3-Vugraphs) The effect of neutron irradiation on the tensile properties and microstructure of several vanadium alloys.** Braski, D.N. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001755/JAW.

From U.S./USSR fusion materials workshop; Oak Ridge, TN, USA (31 Aug 1987).

This paper contains viewgraphs describing the effects of neutron irradiation on the tensile properties and microstructure of vanadium alloys in first wall fusion reactors. A tritium trick experiment was used to study the helium embrittlement and the stresses and strains on these materials in a controlled environment. (LSP)

5265 **(CONF-8709157—1) Initial high-power testing of the ATF [Advanced Toroidal Facility] ECH [electron cyclotron heating] system.** White, T.L.; Bigelow, T.S.; Kimrey, H.D. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000885/JAW.

From Joint workshop on electron cyclotron emission and the electron cyclotron resonance heating; Oxford, UK (16 Sep 1987).

The Advanced Toroidal Facility (ATF) is a moderate aspect ratio torsatron that will utilize 53.2 GHz 200 kW Electron Cyclotron Heating (ECH) to produce nearly current-free target plasmas suitable for subsequent heating by strong neutral beam injection. The initial configuration of the ECH system from the gyrotron to ATF consists of an optical arc detector, three bellows, a waveguide mode analyzer, two TiO_2 mode absorbers, two 90° miter bends, two waveguide pumpouts, an insulating break, a gate valve, and miscellaneous straight waveguide sections feeding a launcher radiating in the TE_{02} mode. Later, a focusing Vlasov launcher will be added to beam the ECH power to the saddle point in ATF magnetic geometry for optimum power deposition. The ECH system has several unique features; namely, the entire ECH system is evacuated, the ECH system is broadband, forward power is monitored by a newly developed waveguide mode analyzer, phase correcting miter bends will be employed, and the ECH system will be capable of operating short pulse to cw. Initial high-power tests show that the overall system efficiency is 87%. The waveguide mode analyzer shows that the gyrotron mode output consists of 13% TE_{01}, 82.6% TE_{02}, 2.5% TE_{03}, and 1.9% TE_{04}. 4 refs.

5266 **(DOE/ER/13447—3) Accurate alpha sticking fractions from improved three-body calculations relevant for muon catalyzed fusion: Progress report, May 1, 1987-September 1, 1987.** Szalewicz, K.; Monkhorst, H.J. (Florida Univ., Gainesville (USA). Dept. of Physics). Sep 1987. Contract FG05-85ER13447. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001722/JAW.

This progress report discusses corrections, revisions and modifications to previous published work on alpha sticking fractions related to three-body calculations relevant to muon catalyzed fusion. 15 refs. (LSP)

5267 **(DOE/OR/21400—T316) Economics of fusion reactors.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 24 Sep 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000580/JAW.

This paper contains viewgraphs on the cost effectiveness of fusion reactors. Some conclusions made in this paper are: the generic reactor model is a useful tool for determining the general features required to make a competitive fusion reactor; the cost of electricity is not a sensitive function of any particular reactor element - either technology or physics; the competitive reactors require moderate advances in physics and technology; key factors to be addressed in the long term are development of low activation materials and overall reactor availability; and a number of magnetic configurations have the potential physics capability to make a competitive reactor.

5268 **(EUR-CEA-FC—1316) Coupling structure calculations for ion cyclotron heating of Tore Supra.** Bannelier, P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Dec 1986. 55p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750075/JAW.

Two structures are studied: antennas and waveguides. After some recalls on transmission lines with losses, the theory is applied to antennas with inner adaptation: the problem is to calculate the impedance necessary for complete adaptation of antenna to the power line and the generator. The Faraday screen role is detailed and studied: the per-unit length loss resistance due to ohmic losses in the screen which lower the plasma-coupled maximum power. Waveguide coupling theory is also presented. Coupling between wave guide and plasma is evaluated.

5269 **(EUR-CEA-FC—1322) Computer study of an energy recovery system for the Tore-Supra neutral beam injection lines.** Pamela, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Jan 1987. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750493/JAW.

The prototype of an Energy Recovery System (ERS) has been designed for the Tore-Supra neutral beam injection lines (100 kV, 40 A deuterium beams). Our study, based on computer calculations using a 2-D charged particle trajectory program, consisted mainly in the optimisation of the components of the ERS, but it has been extended in order to draw general conclusions on some problems that might be encountered and to derive scaling laws for the suppression voltage determination. In our system, the power saving can be as large as 1 MW per injection line, i.e. about 25 % of the total power that would be spent without energy recovery. The recovery on higher energy beams has also been investigated; the power gain would be even larger in this case.

5270 **(IAE—4300/7) Study on the mechanical stresses in the elements of the model of a toroidal magnet of a tokamak with strong field.** Makhutov, N.A.; Prigorovskij, N.I.; Fomin, A.V.; Alekseev, Yu.A.; Kisula, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700343/JAW.

The results of studies on the mechanical stresses in the toroidal magnet model of a tokamak with strong field are considered. The results of experiments carried out by the brittle strain-sensitive coating method concerning the most stessed zone of the model design are presented. The results of design experiments aimed at determination of the stressed-deformed state inside the model on the basis of limited experimental data obtained in the zones accessible for installation of measuring equipment. 8 refs.; 8 figs.

5271 **(IAE—4315/8) Study on the model of a toroidal magnet for a tokamak with a strong field.** Andrianov, A.M.; Alekseev, Yu.A.; Baryshev, V.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700346/JAW.

A study was made on the model of a toroidal magnet for a tokamak with strong field and combined adiabatic compression of

plasma filament. Results of measuring basic electrotechnical parameters of the model, investigations of stress-strained state (SSS) of the most stressed central part of model structure (conducting turn and band) are presented. Results of testing basic structural materials of magnet coil-chromium and chromozirconium bronzes - are given as well. SSS model was studied with the use of methods for measuring mechanical stresses, based on application of brittle oxide and photoelastic coatings. It is shown that about 21 T fields can be achieved in the magnet. 17 refs.; 17 figs.

5272 **(IAE—4320/10) Results of experimental study on process of cool-down of model section and test unit of a superconducting winding of toroidal field of T-15 device at tue SIMS complex.** Anashkin, I.O.; Ivanov, D.P.; Kiknadze, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700348/JAW.

The cooling-down of the test unit and experimental sections of a toroidal field superconducting winding (TFSW) of the T-15 thermonuclear device is experimentally studied at the complex of stands for testing magnetic systems of the Kurchatov Institute of Atomic Energy. The experimental data on temperature distributions in the test unit housing and winding under cooling-down conditions are obtained. At the cooling rate of 5-6 K/h the maximum temperature gradients do not exceed 30-35 K along the radius and 60-65 K along the azimuth. Under these conditions there appear stresses inside the housing comparable with the yield point of the housing material. The oscillations of thermomechanical stresses, being a probable indication of the crack formation in the compound, are detected. 16 refs.; 13 figs.; 4 tabs.

5273 **(IAE—4326/7) Gas feed system for the T-15 tokamak discharge chamber.** Gulyaev, V.A.; Levkov, B.S.; Maslennikov, E.A.; Notkin, G.E.; Polkanov, V.N.; Shchedrov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700351/JAW.

Hydrogen (deuterium) and rare gas feed system for the T-15 tokamak discharge chamber is described. Fast-response pulsed piezovalve designs used in the gas feed system are presented. Problems of automated gas feed control, depending on discharge chamber wall gass saturation, diaphragm and plasma parameters, are considered. 5 refs.; 7 figs.

5274 **(IPP—1/230) Shear strength of the ASDEX upgrade TF coil insulation: Rupture, fatigue and creep behaviour.** Streibl, B.; Maier, E.A.; Perchermeier, J.; Cimbrico, P.L.; Varni, G.; Pisani, D.; Deaka, R.; Endreat, J.; Schaefer, R. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.). Bereich Neue Technologie; Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.)). Mar 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750435/JAW.

This report is concerned with the interlaminar shear strength of the insulation system for the 16 toroidal field (TF) coils of ASDEX upgrade. The interlaminar shear properties of the glass-epoxy insulation are primarily determined by the resin system (ARALDIT-F, HT 907, DZ 40) and its curing procedure. The pure resin was therefore tested first in tension. The results were taken into account for setting up the method of curing the TF coils. Shear tests of the complete glass-epopxy system were then conducted with tubular torque specimens providing a nearly homogeneous stress distribution. In particular, the influence of the amount of flexibilizer (5, 10, 15 parts of resin weight = PoW) on the rupture and fatigue strengths was assessed at a temperature T=60 C, as also was the temperature dependence of the creep rate (40 C, 60 C, 80 C). The results obtained are not based on safe statistics. Nevertheless, they show clear trends.

5275 **(IPP—1/238) Pellet ablation in the W VII-A stellarator.** Buechl, K.P.; Cattanei, G.; Dorst, D.; Elsner, A.; Erckmann, V.; Gasparino, U.; Grieger, G.; Grigull, P.; Hacker, H.; Hartfuss, H.J. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750446/JAW.

Pellets of different sizes (0,6, 0,8 and 1.0 mm diameter) are injected into stellarator plasmas with ohmic, ECR, and neutral injection heating. The direct particle depositon inside the plasma was incomplete for large pellets with total penetration and for ECRH plasmas generally. In NIH plasmas the total mass of the pellets was deposited and the density rise without increase of impurities resulted in energy contents of 4.8 kJ which exceeds the values for gas-fuelled discharges: Radiation fluctuations during pellet ablation are also observed in a stellarator for the first time.

5276 **(IPP—9/60) Surface composition of the Be limiters and the stainless-steel torus wall after operation in UNITOR.** Martinelli, A.P.; Behrisch, R.; Hammer, H.; Hackmann, J. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Duesseldorf Univ. (Germany, F.R.). Physikalisches Inst. - Lehrstuhl 2). Dec 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750431/JAW.

The surfaces of two Be limiters and of a test sample from the stainless-steel torus wall used in UNITOR were analyzed by RBS, PIXE, AES, and SEM/EIXE. The main foreign atoms found on the limiters are 0 (2 x 10/sup 17/ to 2 x 10/sup 18//cm/sup 2/), Fe, Ni, Cr and Sn (2 x 10/sup 15/ to 2 x 10/sup 16//cm/sup 2/). There are no large differences in the foreign atom coverage on the different surface areas of the limiters. Generally, the front surfaces of the limiters show slightly lower coverage than the sides. On limiter 2, the Sn coverage is about a factor of 4 larger than on limiter 1, indicating that the Sn source was close to this limiter. The stainless-steel test sample from the torus wall shows islands of BeO, which can be attributed to splashes or droplets eroded from the limiters during disruptions. Major erosion of the limiters occurrd only during the first 100 shots, when many discharges were terminated by disruptions. Redeposited wall material is found on the wall sample which partly covers the BeO deposits. The surface modifications of limiters and wall samples were discussed by taking into account the particle fluxes from and to the walls and limiters.

5277 **(KFK—4268) Studies of a modular advanced stellarator reactor ASRA6C.** Boehme, G.; El-Guebaly, L.A.; Emmert, G.A.; Grieger, G.; Harmeyer, E.; Herrnegger, F.; Huebener, J.; Jentzsch, K.; Kisslinger, J.; Komarek, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion; Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1987. 241p. (FPA—87-2; IPP—2/285). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750445/JAW.

This study is directed towards the clarification of critical issues of advanced modular stellerator reactors exploiting the inherent potential of steady state operation, and is not a point design study of a reactor. Critical technology issues arise from the three-dimensional magnetic field structure. The first wall, blanket and shield are more complex than those of axi-symmetric systems, but this is eased at moderate to large aspect ratio typical of stellarators. Several blanket options have been studied and a thin blanket (21 cm) was the first choice for the design. Superconducting modular coils were investigated with respect to the conductor and mechanical supports. From the analysis of forces and stresses caused by the electromagnetic loads the coils are considered to be feasible, although shear stresses might pose a critical issue. Demountable intermagnetic support elements were designed for use at separation areas between the cryostat modules. A scheme for remote reactor maintenance was also developed. The plasma physics issues of different configurations were studied using extrapolations of transport behaviour and equilibrium from theory and present experiments. These studies indicate that the confinement and equilibrium behaviour is adequate for ignited operation at an average value of 5%

beta. Impurities may pose a critical issue. Several impurity control operations were investigated; a pumped limiter configuration utilizing the 'ergodic layer' at the plasma edge was chosen for edge plasma and impurity control. A general conclusion of the study is that the modular stellerator configuration offers interesting prospects regarding the development towards steady-state reactors.

5278 **(KFK—4271) Potential and problems of an aqueous lithium salt solution blanket for NET.** Kuechle, M.; Bojarsky, E.; Dorner, S.; Fischer, U.; Reimann, J.; Reiser, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Jul 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750440/JAW.

The report describes design studies on a water cooled invessel shield blanket for NET and its modification into an aqueous lithium salt blanket. The shield blankets are exchangable against breeding blankets and fulfill their shielding and heat removal functions. Emphasis is on simplicity and reliability. The water cooled shield is a large steel container in the shape of the blanket segment which is filled by water and containes a grid structure of poloidally arranged steel plates. The water flows several times in poloidal direction through the channels formed by the steel plates and is thereby heated up from 40degC to 70degC. When the water is replaced by an aqueous lithium salt solution the shield can be converted into a tritium breeding blanket without any design modification or invessel component replacement. When compared with other concepts this blanket has the advantage that the solution can replace water cooling also in the divertor and in segments dedicated to plasma heating and diagnostics, what increases the coverage considerably. Extensive three-dimensional neutronics calculations were done which, together with literature studies on candidate materials, corrosion, and tritium recovery led to a first assessment of the concept. There is an indication that no major corrosion problems are to be expected in the low temperature region envisaged. Tritium recovery capital costs were estimated to be in the 20 MECU to 50 MECU range and tritium breeding ratio is comparable to the best breeding blanket.

5279 **(LA-UR—87-3209) A short introduction to the status and motivation for reversed field pinch and compact toroid research.** Dreicer, H. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 22p. (CONF-870908—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000487/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

Potential commercial fusion power systems must be acceptable from a safety and environmental standpoint. They must also promise to be competitive with other sources of energy (i.e., fossil, fission, etc.) when considered from the standpoint of the cost of electricity (COE) and the unit direst cost (UDC) in ($/kWe). These costs are affected by a host of factors including recirculating power, plant availability, construction time, capital cost etc., and are, thus, influenced by technological complexity. In a attempt to meet these requirements, the emphasis of fusion research in the United States has been moving toward smaller, lower-cost systems. There is increased interest in higher beta tokamaks and stellarators, and in compact alternate concepts such as the Reversed Field Pinch (RFP) and the Compact Toroids (CTs) which are, in part, the subject of this paper.

5280 **(LA-UR—87-3462) The TITAN magnet configuration.** Bathke, C.G. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-871007—38). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001826/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The TITAN study uses copper-alloy ohmic-heating coils (OHC) to startup inductively a reversed-field-pinch (RFP) fusion reactor. The plasma equilibrium is maintained with a pair of superconducting equilibrium-field coils (EFCs). A second pair of copper EFCs provides the necessary trimming of the equilibrium field during plasma transients. A compact toroidal-field-coil (TFC) set is provided by an integrated blanket/coil (IBC). The IBC concept also is applied to the toroidal-field divertor coils. Steady-state operation is achieved with oscillating-field current drive, which oscillates at low amplitude and frequency the OHCs, EFCs, the TFCs, and divertor coils about their steady-state currents. An integrated magnet design, which uses low-field, low technology coils, and the related design basis is given. 18 refs.

5281 **(LA-UR—87-3464) Edge plasmas and plasma/wall interactions in an ignition-class reversed field pinch.** Werley, K.A.; Bathke, C.G.; Krakowski, R.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871007—39). NTIS, PC A02. Order Number DE88001825/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A range of limiter, armor, and divertor options are examined as a means to minimize plasma/wall interactions for a high-power-density, ignition-class reversed field pinch. An open, toroidal-field divertor can operate at maximum powers, while isolating the core plasma from impurities and protecting the wall. 16 refs.

5282 **(LA-UR—87-3468) A DT fusion neutron source based on the reversed-field pinch.** Bathke, C.G.; Krakowski, R.A.; Miller, R.L.; Werley, K.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—28). NTIS, PC A02. Order Number DE88001814/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Results are presented from a preliminary scoping study of an ohmically-heated reversed-field pinch (RFP) operating with a steady-state DT fusion neutron wall loading in the range of 1 to 5 MW/m^2 while generating less than 100 MW total fusion power. These results are also useful in projecting the development of ignition/burn RFPs, as well as offering an economic source of DT neutrons for fusion nuclear testing. 14 refs.

5283 **(LA-UR—87-3469) Design and analysis of a structural system for ZTH.** Giger, A.J.; Hill, J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871007—18). NTIS, PC A02. Order Number DE88001813/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A structural support system comprised largely of laminated epoxy fiberglass bulkheads has been designed for the ZTH air core machine, the initial experiment in the Confinement Physics Research Facility (CPRF) at LANL. Fiberglass was chosen to minimize magnetic field errors due to eddy currents. Magnetic fields for ZTH are produced, in part, by 18 poloidal field (PF) coils. Sixteen, equally spaced, 4 inch thick, radial G-10 bulkheads, positioned and held by a series of stainless steel ring beams, support the PF coils and the toroidal front end assembly. PF coils transfix and are supported by the bulkheads at locations dictated by magnetic field effects. The toroidal front end is mounted to the bulkheads by a spline ensuring constant alignment with the coil set while allowing differential expansion. The entire machine assembly is mounted on a central concrete cylinder with outboard stainless steel columns. Finite element analyses were performed as an integral part of the design process for the ZTH structure. Because of irregular shapes, multiple materials, different load cases and numerous geometric discontinuities conventional analyses of the structure could not be performed. Static and dynamic coil loads were applied to a model of the prototype support system to examine structural response. A discussion of the model, assumptions, load cases, boundary conditions, and results is given. Influence of the results on the design are presented. 3 refs.

5284 **(LA-UR—87-3470) Design of the ZTH vacuum liner.** Prince, P.P.; Dike, R.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871007—17). NTIS, PC A02. Order Number DE88001812/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The current status of the ZTH vacuum liner design is covered by this report. ZTH will be the first experiment to be installed in the CPRF (Confinement Physics Research Facility) at the Los Alamos National Laboratory and is scheduled to be operational at the rated current of 4 MA in 1992. The vacuum vessel has a 2.4 m major radius and a 40 cm minor radius. Operating parameters which drive the vacuum vessel mechanical design include a 300 C bakeout temperature, an armour support system capable of withstanding 25 kV, a high toroidal resistance, 1250 kPa magnetic loading, a 10 minute cycle time, and high positional accuracy with respect to the conducting shell. The vacuum vessel design features which satisfy the operating parameters are defined. The liner is constructed of Inconel 625 and has a geometry which alternates sections of thin walled bellows with rigid ribs. These composite sections span between pairs of the 16 diagnostic stations to complete the torus. The thin bellows sections maximize the liner toroidal resistance and the ribs provide support and positional accuracy for the armour in relation to the conducting shell. Heat transfer from the vessel is controlled by a blanket wrap of ceramic fiber insulation and the heat flux is dissipated to a water cooling jacket in the conducting shell.

5285 **(LBL-PUB—621-8/87) Heavy-ion accelerator research for inertial fusion.** (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000541/JAW.

Thermonuclear fusion offers a most attractive long-term solution to the problem of future energy supplies: The fuel is virtually inexhaustible and the fusion reaction is notably free of long-lived radioactive by-products. Also, because the fuel is in the form of a plasma, there is no solid fuel core that could melt down. The DOE supports two major fusion research programs to exploit these virtues, one based on magnetic confinement and a second on inertial confinement. One part of the program aimed at inertial fusion is known as Heavy Ion Fusion Accelerator Research, or HIFAR. In this booklet, the aim is to place this effort in the context of fusion research generally, to review the brief history of heavy-ion fusion, and to describe the current status of the HIFAR program.

5286 **(OEFZS—4402) Particle transport in microdetonations.** Kamelander, G.; Sdouz, G.; Woloch, F.; Koinig, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1987. 98p. (In German). (RS—292/87). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700066/JAW.

In most of the standard codes for numerical simulation of the explosion of inertial confinement fusion pellets the particle transport is neglected. The present report constitutes the resume of a project to investigate the effects of inclusion of reaction particle transport into the physical model of a simulation code. It is shown that the transport effect may become important in some cases.

5287 **(SAND—87-0312) Erosion corrosion of copper in a high velocity water environment.** Dobson, R.L.; Whitley, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001933/JAW.

In certain fusion energy applications, high velocity, subcooled water must be provided to cool high heat flux components. Because of its heat transfer properties, copper proves to be an attractive material to use for the coolant tube walls. However, the existing literature pertaining to the effect of high water velocities (>7 m/s) on copper tubing is extremely limited. Thus, a study of the erosion corrosion of copper tubing and one of its alloys (Glidcop Al-15) was carried out for approximately 582 hours with water circulating at 12 m/s. Evidence of erosion corrosion was found and, in general, to a greater extent in the copper than in the Glidcop. 11 refs.

5288 **(SAND—87-1291C) Conceptual design of a 10 MJ driver for a high gain Target Development Facility.** Olson, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871007—13). NTIS, PC A02. Order Number DE88001651/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Commercial application of inertial confinement fusion (ICF) will require inexpensive, high gain (>80) fusion targets. It is thought that the development of such targets will require a 5 to 10 year research effort utilizing a dedicated nuclear research facility with a driver capable of providing a 10 MJ, 300 to 1000 TW pulse of on-target energy. The "Target Development Facility" (TDF) is a light ion driven concept for such a facility. A TDF driver based upon extrapolations from present-day pulsed power technology is described in the present paper. 18 refs.

5289 **(SAND—87-1292C) Conceptual design of a high gain Target Development Facility.** Olson, R.E.; Cook, D.L.; Moses, G.A.; Bruggink, D.; Engelstad, R.L.; Henderson, D.L.; Lovell, E.G.; Peterson, R.R.; Sawan, M.E.; Yasar, O. (Sandia National Labs., Albuquerque, NM (USA); Wisconsin Univ., Madison (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871007—14). NTIS, PC A02. Order Number DE88001652/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Critical design issues associated with a light ion driven high gain Target Development Facility (TDF) have been explored in a preliminary conceptual design study. Calculational mthods and key conclusions related to the TDF target chamber concept are described in the present paper. 19 refs.

5290 **(UCRL—15649-Vol.2) Photodetachment neutralizer development: Laser window design study: Volume 2, Window design details: Final report.** (TRW Energy Development Group, Redondo Beach, CA (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000783/JAW.

During 1983, TRW conducted a photodetachment neutralizer development (PDN) - Laser Resonator study. The emphasis of this contract was to assess a technology base of the PDN concept. Three technology assessments were conducted: Mirror Technology assessments, Window Engineering Analysis/Technology assessment, and COIL medium modeling with emphasis on PDN issues. Based on the results of these technology assessments the follow-on contract was funded to develop a technology verification. Due to funding limitations this technology verification program was divided into two separate follow-on contracts. Under this follow-on contract, the following tasks were performed: Measure Attenuation Coefficient of 3M FC-104, FC-77, FC-43 with temperature and attenuation coefficient of sapphire, generate finite element/finite difference thermal/structural model of the HEX double window, determine thermal/structural response from the proposed operating conditions, develop option response data from the deflection/stress inputs, recommend design and operating parameters for demonstrator and operational HEX double window, generate Level 1 layouts and drawings of double paned demonstrator window and window mount/manifold, and generate preliminary layout drawings of shutter. Thermal and structural analyses were conducted for both the operational and demonstrator window heat exchanger (HEX) designs and operating conditions.

5291 **(UCRL—96199) Fusion neutron irradiation induced ordering and defect production in Cu_3Au at high temperatures.** Huang, J.S.; Guinan, M.W.; Kirk, M.A.; Hahn, P.A. (Lawrence Livermore National Lab., CA (USA); Argonne National Lab., IL (USA)). Aug 1987. Contract W-7405-ENG-48;W-31-109-ENG-38. 21p. (CONF-871036—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014244/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

We irradiate three Cu_3Au alloys different degrees of initial long-range order at temperatures between 300K and 434K. The re-

sistivity of samples is monitored during irradiation and related to the long-term order parameter by the Muto relation. The results show that the ordering rate, which is proportional to the concentration of freely migrating vacancies, increases at the beginning and then decreases later with fluence. The decrease is a result of the continuous production of sinks in the form of dislocation loops. The effect of sinks on vacancy annihilation in some cases causes a reversed temperature dependence of ordering rate. The free vacancy production rate and the rate of sink production are determined using an ordering kinetics theory. The results of the 14 MeV neutron irradiations are compared to those obtained in other neutron spectra and particle irradiations. The estimated free vacancy production rate is also compared to the primary defect production rate measured at 4.2K in disordered samples.

5292 **(UCRL—96663) Using the Nova target chamber for high-yield targets.** Pitts, J.H. (Lawrence Livermore National Lab., CA (USA)). 28 Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—7). NTIS, PC A02. Order Number DE88000965/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The existing 2.2-m-radius Nova aluminum target chamber, coated and lined with boron-seeded carbon shields, is proposed for use with 1000-MJ-yield targets in the next laser facility. The laser beam and diagnostic holes in the target chamber are left open and the desired 10^{-3} Torr vacuum is maintained both inside and outside the target chamber; a larger target chamber room is the vacuum barrier to the atmosphere. The hole area available is three times that necessary to maintain a maximum fluence below 12 J/cm² on optics placed at a radius of 10 m. Maximum stress in the target chamber wall is 73 MPa, which complies with the intent of the ASME Pressure Vessel Code. However, shock waves passing through the inner carbon shield could cause it to comminute. We propose tests and analyses to ensure that the inner carbon shield survives the environment. 13 refs.

5293 **(UCRL—96679) Study of fueling requirements for the Engineering Test Reactor.** Ho, S.K.; Perkins, L.J. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—24). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001895/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An assessment of the fueling requirement for the TIBER Engineering Test Reactor is studied. The neutral shielding pellet ablation model with the inclusion of the effects of the alpha particles is used for our study. The high electron temperature in a reactor-grade plasma makes pellet penetration very difficult. The launch length has to be very large (several tens of meters) in order to avoid pellet breakage due to the low inertial strength of DT "ice." The minimum repetition rate corresponding to the largest allowable pellet, is found to be about 1 Hz. A brief survey is done on the various operational and conceptual pellet injection schemes for plasma fueling. The underlying conclusion is that an alternative fueling scheme of coaxial compact-toroid plasma gun is very likely needed for effective central fueling of reactor-grade plasmas. 16 refs.

5294 **(UCRL—96698) Neutronics issues for a laboratory microfusion facility.** Tobin, M.T. (Lawrence Livermore National Lab., CA (USA)). 6 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—6). NTIS, PC A02. Order Number DE88000966/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Discussion concerning goals or design of the Laboratory Microfusion Facility (LMF) should include an understanding of the neutronics issues involved. We consider such aspects as first wall shielding requirements, safety standards as they will apply to such an Inertial Confinement Fusion (ICF) facility, and the interior chamber environment. The selection of materials for the first wall, neutron moderator and absorber, and gamma ray shielding is discussed. We conclude that water or carbon are the choices for bulk neutron moderation and boron placed just in front of the first wall the choice for neutron absorber. Selection of the in-chamber materials and diagnostic design will greatly affect the relative hazards after a shot. Lead is the high-Z material of choice and plastic expendables for the diagnostics. Although a poor gamma ray attenuator, carbon is the choice for this function since it also compensates for the direct neutron shine effects and does not itself activate. Electronics may need to be hardened to the prompt gamma and neutron dose.

5295 **(UCRL—96867) A cryogenic system for TIBER II [Tokamak Ignition/Burn Experimental Reactor].** Slack, D.S.; Kerns, J.A. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—25). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001898/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Phase II of the Tokamak Ignition/Burn Experimental Reactor (TIBER II) study describes one option for a small, economical, next-generation tokamak [1,2]. Because of its small size, minimum shielding is used between the plasma and the toroidal-field (TF) coils. Consequently, a large cryogenic system (approximately 70 kW at 4.5 K) capable of delivering forced-flow helium is required. This paper describes a cryogenic system that meets this requirement and includes TIBER-II requirements. 3 refs.

5296 **(UCRL—97280) A D-T neutron source for fusion materials and technology testing.** Coensgen, F.H.; Casper, T.A.; Correll, D.L.; Damm, C.C.; Futch, A.H.; Molvik, A.W.; Bulmer, R.H. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1987. Contract W-7405-ENG-48. 30p. (CONF-870908—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000422/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

This report describes a conceptual design of a high-fluence source of 14 MeV D-T neutrons for accelerated testing of materials. The design goal of 10 MW/m² year corresponding to 100 displacements per atom per year is taken to be sufficient for end-of-life tests of candidate materials for a fusion reactor. Such a neutron source would meet a need in the program to develop commercial fusion power that is not yet addressed. In our evaluation, a fusion-based source is preferred for this application over non-fusion, accelerator-type sources such as FMIT because, first, a relevant 14 MeV D-T neutron spectrum is obtained. Second, a fusion source will better simulate the reactor environment where materials can be subjected to high thermal loads, energetic particle irradiation, high mechanical stresses, intense magnetic fields and high magnetic field gradients as well as a 14 MeV neutron flux of several MW/m². Although the actual reactor environment can be realized only in a reactor, a fusion-based neutron source can give valuable design information of synergistic effects in this complex environment. The proposed small volume, high-fluence source would complement the capabilities of a facility such as ITER, which addresses toroidal fusion component development. For our source, the volume of reacting plasma and the fusion power have been minimized, while maintaining an intense neutron flux. As a consequence, tritium consumption is modest, and the amount of tritium required is readily available.

5297 **Foam shell cryogenic ICF target.** Darling, D.H. (to Dept. of Energy, Washington, DC). US Patent 4,693,938. 15 Sep 1987. Filed date 7 Nov 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an inertial confinement fusion target comprising a hollow spherical shell of low density, low Z, open cell, rigid foam saturated with liquid DT.

5298 **Activation product transport in a FLiBe-vanadium alloy-HT9 system.** Klein, A.C.; Sze, D.K. (Oregon State Univ., Corvallis, USA. Dept. of Nuclear Engineering; Argonne National Lab., IL, USA. Fusion Power Program). *Journal of Nuclear Materials*; **149**: No. 2, 261-265(Jul 1987). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

An assessment is made of the gamma radiation hazards likely to be found around a fusion reactor heat transfer and tritium breeding loop which employs a vanadium alloy for the blanket and first wall structure and the ferritic-steel HT9 for the remainder of the loop. The coolant/tritium breeding fluid is the molten metallic salt FLiBe. Since the radiation levels near the primary loop components are found to be less than 100 mR/h 3-5 days after shutdown after three years of continuous full power operation, limited hands-on maintenance could be allowed. The very short half-lives of the predominant corrosion products make this result possible and make such a system very attractive.

5299 **Power oscillator circuit modeling and redesign for the Particle Beam Fusion Accelerator II (PBFA-II) switch trigger laser.** Smith, D.L.; Hamil, R.A.; Prestwich, K.R.; Rohwein, G.J.; Donovan, G.L.; Schaub, C.M. (Sandia National Labs., Albuquerque, NM). pp 18-25 of Pulse power for lasers. Burkes, T.R. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—). Contract AC04-76DP00789.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The energy output and reliability of the multi-joule, injection-locked KrF laser used to trigger the PBFA II accelerator gas switches were improved through modifications identified in modeling the Blumlein driver circuit for the power oscillator. A combination of the SCEPTRE/sup 1/ network solver code and JASON / sup 2/ electrostatic field code were used to model the laser pulse-forming circuit in its single-channel rail gap configuration and modified versions with three or five discrete switches across the 1.45-m-wide, water-insulated transmission line. Three regularly spaced trigatron spark gaps resulted in a more uniformly driven laser volume with lower variations in voltages (10%) and rise times (9%) along its length. With the new configuration, over 3000 shots have been recorded without a single misfire compared to an average of —25 shots before a prefire with the original design. The gas mix and pressure had to be optimized to match a given driver pulse voltage and rise time to achieve maximum performance from the laser. We summarize the model results which led to our decision to change the Blumlein switch configuration.

5300 **Health physics appraisal guidelines for fusion/confinement devices.** Neeson, P.M. (U.S. Dept. of Energy, Chicago Operations Office, 9800 South Cass Avenue, Argonne, IL 60439). pp 330-337 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—).

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Several types of fusion/confinement devices have been developed for a variety of research applications. The health physics considerations for these devices can vary, depending on a number of parameters. This paper presents guidelines for health physics appraisal of such devices, which can be tailored to apply to specific systems. The guidelines can also be useful for establishing ongoing health physics programs for safe operation of the devices.

5301 **Radiation associated with an inertial confinement fusion laser system.** Singh, M.S. (Lawrence Livermore National Lab., P.O. Box 5505, Livermore, CA 94550). pp 346-355 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract W-7405-ENG-48.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The primary objective of the LLNL Laser Fusion Program is to understand and develop the science and technology of inertial confinement fusion. Nova, a 100-TW/100-kJ laser system, has demonstrated efficient compression, ignition, and burn of D-T fusion fuel. The LLNL fusion computer program (LASNEX) and experiments strongly support achieving high gain with the proposed multi-MJ laser system. In this paper, the author examines the prompt and residual radiations associated with these laser systems.

99 GENERAL AND MISCELLANEOUS

5302 **(CONF-8703158—) Committee reports of the international workshop on Printing Flaw Standards for Machine Inspection.** Johnson, C.K.; Burnett, M.N.; Goodman, C.A. (eds.). (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 70p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88000780/JAW.

From Printing flaw standards for machine inspection conference; San Diego, CA, USA (30 Mar 1987).

The main purpose of the workshop was to establish international flaw standards that can facilitate specification of functional requirements for machine inspection equipment. Participants were representatives from the international communities of security printing and industrial machine inspection with extensive experience in their respective fields. Reports are given by the committees on: printing flaw nomenclature and quantization, flaw-severity perception and polling, flaw detection requirements for intaglio and offset intaglio currency, flaw detection requirements for postage stamps, machine inspection capabilities and limitations, and machine inspection specification recommendations.

5303 **(DOE/MA—0287-3) Listing of awardee names: Active awards as of October 15, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 15 Oct 1987. 572p. NTIS, PC A24/MF A01; 1; GPO Dep. Order Number DE88001917/JAW.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy.

5304 **(DOE/MA—0301-1) Listing of awardee names: Retired awards as of October 15, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 15 Oct 1987. 890p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88002374/JAW.

This document is a computerized listing issued semiannually from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. (Retired is defined as awards that have been closed out and retired at the time of issuance of the listing.)

5305 **(GB—106) World Energy Conference annual report 1986.** (World Energy Conference, London (UK)). Jun 1987. 61p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The 1986 annual report of the World Energy Conference (WEC) is presented. Contents include the conclusions arising from the 13th WEC Congress held in Cannes in 1986, the Officers and Executive Council of WEC, reports of WEC's symposia, technical studies and regional meetings and future WEC congresses. Finally the financial report and accounts are presented and a list is given of WEC publications.

5306 **(LA—11050-MS) Publications of Los Alamos research, 1986.** Sheridan, C.J.; McClary, W.J.; Rich, J.A.; Dussart, S.A.; (comps.). (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001943/JAW.

This bibliography lists unclassified publications of work done at the Los Alamos National Laboratory for 1986. The entries, which are subdivided by broad subject categories, are cross-referenced with an author index and a numberic index.

5307 **(ORNL/M—336) Oak Ridge National Laboratory review: Volume 20, No. 2, 1987.** Krause, C.; Zucker, A.; Corrill, L. (eds.). (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002137/JAW.

After a brief statement on the 1986 state of the laboratory, science highlights in collaborative research are presented: an attempt to recreate the first moments of the Big Bang, surface modification techniques in electronics, assessing home radon levels in five states, managing international integrated forest study, US-Japan joint breeder reprocessing project, optical components for SDI, evaluating the Chernobyl reactor accident, fusion superconducting magnet and fueling, scanning tunneling microscope, laser-processed solar cells, explosive trace detector, parallel computer processing algorithms, risk of fertilized egg to teratogens, trees for biomass energy, toxic waste leaching test, corn fermentation, and electricity distribution automation at Athens, TN. Milestones, other programs, the HFIR situation, book publications, and news are finally given. (DLC)

9901 Management

REFER ALSO TO CITATION(S) 5354

5308 **(ASNT/GD—7) Training at the Australian School of Nuclear Technology.** Culley, D.; Fredsall, J.R.; Toner, B. (Australian School of Nuclear Technology, Lucas Heights). Apr 1987. 7p. (CONF-870905—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700295/JAW.

From 6. Pacific Basin nuclear conference; Beijing, China (6 Sep 1987).

The Australian School of Nuclear Technology (ASNT) was founded in 1964 as a joint enterprise of the Australian Atomic Energy Commission and the University of New South Wales to support nuclear developments primarily in Australia. However, ASNT has developed into an important centre for nuclear science and technology training within the South East Asian Region with participants also attending from countries outside this Region.

5309 **(BARC—1357) Permanent phonetic identification code for radiation workers.** Khatua, R.; Somasundaram, S.; Srivastava, D.N. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700305/JAW.

This report describes a system of self-checking short and easily memorisable 4-digit 'Permanent Phonetic Radiation Code' (PPRC) using radix 128 for Indians occupationally exposed to radiation, to facilitate entry of all radiation dose data pertaining to an individual in a single record of a file. The logic of PPRC is computer compatible. The necessary computer program has been developed in Health Physics Division for printing the PPRCs in Devanagari script through dot-matrix printers for making it understandable to the majority of the persons concerned. 16 tables, 3 figures, 8 refs.

5310 **(CNEA-NT—32/85) Summary of activities of the Research Branch during 1983.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Direccion de Investigaciones y Desarrollo). Nov 1985. 114p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700012/JAW.

A summary of the activities performed during 1983 by the C.N.E.A.'s Research Branch in basic and applied research is given. The main activities and achievements obtained are shown in the following areas: 1) Physics Department: Tandar Project; Experimental Nuclear Physics; Theoretical Nuclear Physics; Solid State Physics; Technical Assistance and Engineering. 2) Reactor's Chemistry Department with its divisions: Radiation Chemistry; Chemical Control; Moderator and Coolant Physical Chemistry. 3) Radiobiology Department: Radiation Pathology; Genetics; Molecular Genetics; Somatic Effects; Radiomicrobiology; Irradiation and Dosimetry; Bioterium. 4) Prospective Department and Special Studies; Nuclear Fusion and Solar Energy and also, Biomathematics; Labelled Molecules and Radiochemistry. (M.E.L.).

5311 **(CNEA-NT—37/85) Progress report 1983-1984 Reactor Chemistry Department.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica de Reactores). Nov 1985. 461p. (In Spanish). NTIS (US Sales Only), PC A20/MF A01. Order Number DE88700014/JAW.

Description of the activity developed by the Reactor Chemistry Department of the National Atomic Energy Commission during the period 1983-1984 in its four divisions: Chemical Control; Moderator and Refrigerant Chemistry; Radiation Chemistry and Nuclear Power Plant's Service. A list of the publications made by the personnel during this period is also included. (M.E.L.).

5312 **(CONF-8710160—5) Aiding Air Force budget analysis with expert system tools and techniques.** Hardee, H.K.; Jones, K.A.; Morris, J.D.; Emrich, M.L.; Ali, H. (Oak Ridge National Lab., TN (USA)). 14 Sep 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000566/JAW.

From Southeast meeting of the Institute of Management Sciences; Myrtle Beach, SC, USA (8 Oct 1987).

A system to capture US Air Force financial expertise is currently under development. To accomplish its mission of costing Air Force programs, the Director of the Budget utilizes the services of budget analysts. Analysts are required to prepare three cost exercises during the year: the Program Objective Memorandum (POM), the Budget Estimation Submission (BES), and the President's Budget (PB). Additionally, during budget calls and budget execution, analysts must make decisions regarding funding obligations and outlays. Analysis and modification of outlay projection plans require the use of operational and procedural heuristics. These problem-solving steps followed by analysts are being used to develop a prototype. Information regarding the prototype, the tool, and its capabilities are presented. Additional features of the program are described including integration with existing information management systems.

5313 **(INIS-GB—100) National Nuclear Corporation Limited report and financial statements 31 March 1986.** (Touche Ross International, London (UK)). 1986. 19p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The paper contains the directors' annual report and the audited financial statements of the National Nuclear Corporation Limited, 1985/6. The company is engaged in designing and constructing power stations and nuclear power reactors, and other related work, and in associated research and development. (U.K.).

5314 **(INIS-mf—10996) Progress report 1986 of the Institute for Radium Research and Nuclear Physics (IRK) of the Austrian Academy of Sciences.** Wild, E.; Dirniger, G. (eds.). (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1987. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700040/JAW.

Progress of projects is reported in the fields of theoretical physics, experimental medium energy physics, experimental nuclear physics, neutron induced reactions, nuclear model calculations, evaluation of nuclear data and numerical data processing, dating and isotope geology, applications in medicine, application in geophysics, dosimetry and environmental studies, instrumentation and detectors. 15 contributions contain results and are treated separately. There is also a list of publications. (G.Q.).

5315 **(OEFZS-A—0993) Radiation protection safety report of the Research Centre Seibersdorf for the year 1986.** Mueck, K.; Steger, F.; Hefner, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Apr 1987. 73p. (In German). (ST—144/87). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

The safety report of the Institute for Radiation Protection comprises all measurements which have been performed during the year 1986 to protect the employees and the environment of the Research Centre Seibersdorf. Personnel monitoring was carried out by TL-dosimetry to control the external dosis, by body counting and excretion analysis for the surveillance of inernal exposure according to the Austrian Radiation Protection Law. Persons working in areas of increased exposure risk were additionally surveilled by dosimeters with continuous display. Monitoring of working places was performed by smear tests and measurement of activity concentration in air. The radioactivity emitted from the ASTRA-reactor,

the SAL, the waste-incineration plant and other institutes as well as the radioactive effluents from the water treatment plant were monitored. Beyond this, the environmental surveillance was supplemented by measurements of the activity content of surface air, tap- and surface water, soil and vegetation samples. The result of the environmental surveillance proves that in the year of 1986 no employee or personal of other firms was exposed to a dose above the limits set in the Austrian code of regulations. On the countrary, the maximum annual dose amounted to less than 20% of the regulatory maximum value. The average dose amounted to 1,21 mSv (121 mrem), about 1/40 of the annual limits. The releases to the environment were also well below the limits set by the authorities. This is also demonstrated by measurements in the environment which prove that no influence of the Research Centre on the environment is detectable. Due to the high sensitivity of the surveillance program, however, the consequences of the Chernobyl accident on the environment of the research centre could be clearly and sensitively registered. Emphasis is laid on the elaboration of these consequences and to compare them with releases and environmental activity levels due to the research centre.

5316 (OUP—86-28, pp 3-23) **Auroral research in Norway up to the space age.** Egeland, A.; Brekke, A. (Oslo Univ. Norway. Fysisk Inst.; Tromsoe Univ. Norway. Auroral Observatory). Dec 1986. NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW. (CONF-8508244—).

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

Since Norway is located in and close to the belt of maximum auroral occurrence, this may explain why Norwegian scientists have made such a significant contribution in auroral research. This, however, does not explain why Norwegians have been more active in this field than scientists in our neighboring countries. The same is even true in meteorology. Thus, it seems that Norwegians have concentrated on "outdoor" natural sciences. K.O. Birkeland, F.M. Stoermer and L. Vegard were the first to apply precise methods to study aurora and associated phenomena. They were also the first to propose a realistic theory and to calculate the motion of fast electrons from the Sun to the Earth's polar atmosphere. Through their research, these pioneers discovered many new effects and laid the foundation of our present-day exploration of aurora from space.

5317 (OUP—86-28) **Proceedings of the 13th annual meeting on upper atmosphere studies by optical methods.** Maaseide, K. (ed.). (Oslo Univ. (Norway). Fysisk Inst.). Dec 1986. 398p. (CONF-8508244—). NTIS (US Sales Only), PC A17/MF A01. Order Number DE87753032/JAW.

From 13. annual meeting on upper atmosphere studies by optical methods; Oslo, Norway (19 Aug 1985).

A total of 41 papers were presented under the following session topics: Atmospheric emissions; auroral features and dynamics; auroral pulsations; airglow and atmospheric parameters; atmospheric constituents; instrumentation and data handling; and observation programs. The report presents the full text or abstracts of 31 of the lectures given at the meeting. 25 of the papers are seperate input to the data base from this report.

5318 (UCRL—53825) **Decision analysis of strategic interaction.** Strait, R.S. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002243/JAW.

This dissertation presents, from a decision analysis perspective, a quantitative approach to decision-making with strategic interaction. Most decisions are made with some strategic interaction component, and in many important decisions, strategic interaction is the central issue. Strategic interaction occurs when a decision, or strategy choice, has an important element in the actions of rivals, i.e., other individuals, organizations, or parties. The actions of these rivals, in turn, depend on the rivals' beliefs about the decision-maker's decision (or strategy) choice. 26 refs., 25 figs.

5319 (VTT-EKA-B—3) **Nuclear energy related research. Research programme plan 1987.** Salminen, P. (comp.). (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1987. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753044/JAW.

This annual Research Programme Plan covers the nuclear related research planned to be carried out at the Technical Research Centre of Finland (VTT) in 1987 and funded by the Ministry of Trade and Industry in Finland, the Nordic Council of Ministers and VTT itself.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 3651

5320 (AD-A—183160/1/XAB) **Sequential and parallel matrix computations. Final report, September 1983-30 April 1987.** Datta, B.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Apr 1987. 45p. NTIS, PC A03/MF A01.

One major objectives of the project entitled Sequential and Parallel Matrix Computations were to develop fast sequential and parallel matrix methods for a number of important linear algebraic problems that arise in design and analysis of linear control systems in state space form. Eighteen publications were accomplished during the cause of the grant, including such titles as: An algorithm to assign eigenvalues in a Hessenberg matrix; Sequential and parallel computations and complexities for determining relative primeness, stability, and inertia; and On finding eigenvalue distribution of a matrix in several regions of the complex plane.

5321 (AD-A—183755/8/XAB) **Parallel algorithms for computer vision. Contract report, 31 August 1985-31 August 1986.** Poggio, T.; Little, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1987. 35p. NTIS, PC A03/MF A01.

The general goals of this research effort is to explore the potential applications and performance of fine-grained computer architectures for vision. The body of this report gives a brief overview of the results of the research during the first twelve months of effort. A taxonomy of parallel vision algorithms was refined. Parallel versions of several Class 1 algorithms (for early vision, directly derived from regularization methods) were designed. This preparatory work allowed the implementation of several of these algorithms on the Connection Machine within a few days when it became available to the researchers. Class 2 and 3 algorithms have also been designed, while at the same time studying some of the associated basic problems in recognition and representation.

5322 (AD-A—183859/8/XAB) **Programming environment for parallel vision algorithms. Annual report, February 1986-February 1987.** Brown, C. (California Univ., Bodega Bay (USA). Bodega Marine Lab.). Feb 1987. 32p. NTIS, PC A03/MF A01.

During the second year of the award period, the Computer Science Department of the University of Rochester continued work in: 1) systems support algorithms, 2) the Butterfly programming environment, and 3) vision applications. This research produced several internal and external reports as well as much exportable code. The University of Rochester also employed DARPA Parallel Architecture Benchmark problems to test different algorithms using four different Butterfly programming environments. These tests produced several interesting results and demonstrated that the Butterfly architecture is a flexible general-purpose architecture that can be effectively programmed by non-experts, using tools developed at BBN and Rochester. The University of Rochester is continuing to study the issues and concerns surrounding the effective implementation of parallel algorithms.

5323 **(BDX—613-3768) XCUT: A rule-based expert system for the automated process planning of machined parts.** Brooks, S.L.; Hummel, K.E.; Wolf, M.L. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jun 1987. Contract AC04-76DP00613. 17p. (CONF-871207—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011638/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Automated process planning is becoming a popular research and development topic in engineering and applied artificial intelligence. It is generally defined as the automatic planning of the manufacturing procedures for producing a part from a CAD based product definition. An automated process planning system, XCUT, is currently being developed using rule-based expert system techniques. XCUT will generate process plans for the production of machined piece-parts, given a geometric description of a part's features. The system currently is focused on operation planning for prismatic parts on multi-axis CNC milling machines. To date, moderately complex 2-1/2D prismatic parts have successfully been planned for with approximately 300 rules in the knowledge base. This paper will describe the XCUT system, system architecture, knowledge representation, plan development sequence, and issues in applying expert system technology to automated process planning. 16 refs.

5324 **(BDX—6133769) Using hierarchically structured problem-solving knowledge in a rule-based process planning system.** Hummel, K.E.; Brooks, S.L. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jun 1987. Contract AC04-76DP00613. 17p. (CONF-871207—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011639/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

A rule-based expert system, XCUT, currently is being developed which will generate process plans for the production of machined parts, given a feature-based part description. Due to the vast and dynamic nature of process planning knowledge, a technique has been used in the development of XCUT that segments problem solving knowledge into multiple rule bases. These rule bases are structured in a hierarchical manner that is reflective of the problem decomposition procedure used to generate a plan. An inference engine, HERB (Hierarchical Expert Rule Bases), has been developed which supports the manipulation of multiple rule bases during the planning process. This paper illustrates the hierarchical nature of problem-solving knowledge in the XCUT system and describes the use of HERB for programming with hierarchically structured rule bases. 6 refs., 21 figs.

5325 **(CONF-8710160—4) Expert system aid for military finance.** Morris, J.D.; Emrich, M.L.; Hwang, Ho-Ling; Meador, M. (Martin Marietta Energy Systems, Paducah, KY (USA)). 14 Sep 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000575/JAW.

From Southeast meeting of the Institute of Management Sciences; Myrtle Beach, SC, USA (8 Oct 1987).

Historically, budget preparation processes have been difficult to accomplish. Errors and inconsistencies cause problems for the analyst during budget review. This paper discusses the development and testing of an expert system to aid budget preparation. The prototyping tool, its capabilities, and their application are discussed. Shown are the pilot testing procedures and their role in system development. Current status and enhancements (including software updates and future testing) are also presented. 12 refs., 3 figs.

5326 **(DOE/ER/10954—4) Research and development of finite elements and iterative algorithms for elliptic partial differential equations: Final report, August 1, 1984 through August 31, 1987.** Carey, G.F.; Young, D.M. (Texas Univ., Austin (USA)). 31 Aug 1987. Contract AS05-81ER10954. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001381/JAW.

This study deals with the use of iterative solution algorithms in conjunction with finite element methods for solving partial differential equations arising in mechanics. Some aspects of the work are directed to the question of suitability of classes of techniques for computations on advanced vector and parallel architectures.

5327 **(EGG-M—20287) NATURAL monitor.** Linsenmann, K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 16p. (CONF-871170—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001602/JAW.

From International software AG user's conference; Miami, FL, USA (1 Nov 1987).

The Data Base Administration Unit at EG & G Idaho, Inc. has developed NATMON, a utility that records a "snapshot" of each command and associated information executed during a NATURAL session. The information stored includes: access timing between the teleprocessing (TP) monitor, ADABAS, and NATURAL; the ADABAS ACB; and TP monitor specific information. This information can be recalled, providing programmers and analysts with a troubleshooting tool not currently available from NATURAL.

5328 **(FEI—1694) ASNI software for material radiation creep studying. Block editor on flexible disks.** Solov'ev, Yu.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700325/JAW.

The principles of design and structure of units on flexible magnetic disks and system file organization in the DOS-1800 disk operating system are considered. The advantages and faults of system software for editting diskettes are described. Description of the developed applied program DISK is given. The ASSEMBLER program listing is appended. 3 tabs.

5329 **(JINR—D-11-85-791, pp 50-55) Program ORTOCARTAN for applications in the relativity theory.** Krasinski, A. (Polska Akademia Nauk, Warsaw. Centrum Astronomiczne). 1985. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

A general outline of the program ORTOCARTAN for algebraic computing in the relativity theory is presented. A short history of the program is given. The base-programming language is LISP. The details of the calculation are presented. An example of application of the ORTOCARTAN is given. 8 refs.

5330 **(JINR—D-11-85-791, pp 56-58) GRG computer algebra system in gravitation and general relativity theory.** Zhitnikov, V.V.; Obukhova, I.G. (Moskovskij Gosudarstvennyj Pedagogicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

The main concepts and capabilities of the GRG specialized computer agebra system intended for performing calculations in the gravitation theory are described. The GRG system is written in the STANDARD LISP language. The program consists of two parts: the first one - for setting initial data, the second one - for specifying a consequence of calculations. The system can function in three formalisms: a coordinate, a tetradic with the Lorentz basis and a spinor ones. The major capabilities of the GRG system are the following: calculation of connectivity and curvature according to the specified metrics, tetrad and torsion; metric type determination according to Petrov; calculation of the Bianchi indentities; operation with an electromagnetic field; tetradic rotations; coordinate conversions. 8 refs.

5331 **(JINR—D-11-85-791, pp 71-75) Specialized LISP-VIRTON package.** Raportirenko, A.M. 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

The Virton package for analytical calculations in the Virton-quark model is described. It is written in the Standard LISP language. Its length in the RLISP format is 3500 cards. Using the package one can perform the following calculations: generation of the Feynman diagrams for a studied process; calculation of a matrix element; generation of FORTRAN programs. 6 refs.

5332 (JINR—D-11-85-791, pp 76-81) **DIRAC computer independent program for algebraic calculations with polynomials, tensors and γ-matrices.** Grozin, A.G. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

A simple DIRAC program oriented basically to standard calculations in the quantum field theory that can be applied in any available computer in a man-machine dialog mode in particular. It extremely saves memory and calculating time without losing computer independence. The program is written in PASCAL language. It executes algebraic operation with polynomials, tensors and the Dirac matrices. 5 refs.

5333 (JINR—D-11-85-791, pp 295-300) **Use of symbolic computations for calculating logic circuits and specialized processors.** Aleksandrov, I.N.; Gajdamaka, R.I.; Nikityuk, N.M. 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

Some applied problems in which using symbolic computations the accurate algebraic expressions describing schematic diagrams of standard logic modules, encoding and decoding devices, different types of complex circuits and event selection devices in high energy physics experiments are considered. Symbolic computations open new prospects for complex automation of design works for discrete logic devices starting from setting tables describing circuit functioning and ending with printed circuit interconnection or topology of integrated circuits. 7 refs.

5334 (JINR—D-11-85-791, pp 345-350) **Computer calculations of nonlocal symmetries of system of linear equations for mathematical physics.** Koprnyak, V.V.; Fushchich, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Matematiki). 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

The results of realization of an algorithm in two FORMAC programs for studying theoretical-algebraic properties of systems of partial differential equations, permitting to establish symmetries, are given. The results of program application to the Dirac equation in four-dimensional space-time for 10-component wave function are presented. 7 refs.

5335 (JINR—D-11-85-791, pp 355-360) **Use of computer algebra system in problems of finite-zone integration.** Kostov, N.A.; Shvachka, A.B. 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

The computer algebra systems (CAS) have been widely used in studies of nonlinear differential equations in different fields of mathematical physics. Possible CAS applications in problems of finite-zone integration are discussed. It is shown that CAS enables realization of a wide variety of routine operations which are used by a researcher in his everyday work. Having a well-defined algorithm, CAS appears to be a powerful tool. It is also advisable to use CAS for solving classification problems. 11 refs.

5336 (JINR—D-11-85-791, pp 361-365) **Investigation of nonlinear resonance effect on stability of charged particle motion in cyclic accelerators using computer algebra.** Amirkhanov, I.V.; Zhidkov, E.P.; Zhidkova, I.E. 1985. (In Russian). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW. (CONF-8509417—).

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

The effect of nonlinear resonances on stability of charged particle motion in cyclic accelerators by the Krylov-Bogolyubiv method in higher approximations is studied. The following aspects are studied as well: possible application of computer algebra (REDUCE-2 system) for the above mentioned problems; potentialities of practical application of the Krylov-Bogolyubov asymptotic method in the second and higher approximations. 13 refs.

5337 **(JINR—D-11-85-791) Computer algebra and its applications in theoretical physics.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1985. 376p. (CONF-8509417—). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88780029/JAW.

From International conference on computer algebra and its applications in theoretical physics; Dubna, USSR (17 Sep 1985).

Separate abstracts were prepared for the papers in this conference. (DWL)

5338 **(LA—11024-MS) The Wilson-Fowler spline in a global IGES [Initial Graphics Exchange Specification] coordinate frame.** Dolin, R.M. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001942/JAW.

This report re-examines the original Wilson-Fowler spline. The Wilson-Fowler spline is a two-dimensional, cubic, piecewise-smooth, curve-fitting algorithm. Its defining equations are redeveloped. The intended application of the redevelopment is the Initial Graphics Exchange Specification (IGES) environment. IGES is the current national geometry standard. Splines are by far the most ambiguous form of geometry that IGES deals with. The work contained in this report is an effort to understand the Wilson-Fowler spline, both how it works and how it can be applied to IGES. The two important features of our work are a global Wilson-Fowler spline definition and a scheme for computing normalized offsets.

5339 **(LA—11089-MS) Computer code simulations of explosions in flow networks and comparison with experiments.** Gregory, W.S.; Nichols, B.D.; Moore, J.A.; Smith, P.R.; Steinke, R.G.; Idzorek, R.D. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 70p. NTIS, PC A04/FM A01; 1; GPO Dep. Order Number DE88001946/JAW.

A program of experimental testing and computer code development for predicting the effects of explosions in air-cleaning systems is being carried out for the Department of Energy. This work is a combined effort by the Los Alamos National Laboratory and New Mexico State University (NMSU). Los Alamos has the lead responsibility in the project and develops the computer codes; NMSU performs the experimental testing. The emphasis in the program is on obtaining experimental data to verify the analytical work. The primary benefit of this work will be the development of a verified computer code that safety analysts can use to analyze the effects of hypothetical explosions in nuclear plant air cleaning systems. The experimental data show the combined effects of explosions in air-cleaning systems that contain all of the important air-cleaning elements (blowers, dampers, filters, ductwork, and cells). A small experimental set-up consisting of multiple rooms, ductwork, a damper, a filter, and a blower ws constructed. Explosions were simulated with a shock tube, hydrogen/air-filled gas balloons, and blasting caps. Analytical predictions were made using the EVENT84 and NF85 computer codes. The EVENT84 code predictions were in good agreement with the effects of the hydrogen/air explosions, but they did not model the blasting cap explosions adequately. NF85 predicted shock entrance to and within the experimental set-up very well. The NF85 code was not used to model the hydrogen/air or blasting cap explosions.

5340 **(LA—11098-MS) Mixing Microsoft C and Microsoft FORTRAN program modules on the IBM Personal Computer.** McGirt, F. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01. Order Number DE88001947/JAW.

Techniques that enable the interchangeable use of C or FORTRAN subprograms with either C or FORTRAN main programs are described. These techniques allow subprograms to be written in one of the languages and then called as subprograms with the other language. 5 refs.

5341 **(LA—11099-MS) Fast movement of large data blocks within the 16-megabyte physical address space on the IBM Personal Computer: Model AT.** McGirt, F. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001948/JAW.

Techniques that enable the fast movement of large data blocks within the 16-megabyte physical address space of the IBM Personal Computer - Model AT are described. Performance measurements of functions used to support these techniques are also given. 5 refs.

5342 **(LA-UR—87-2453) Modeling and generating input processes.** Johnson, M.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-871216—1). NTIS, PC A02. Order Number DE87013162/JAW.

From Winter simulation conference; Atlanta, GA, USA (14 Dec 1987).

This tutorial paper provides information relevant to the selection and generation of stochastic inputs to simulation studies. The primary area considered is multivariate but much of the philosophy at least is relevant to univariate inputs as well. 14 refs.

5343 **(LBL—23275) Who goes there? A dialogue of questions and answers about benign hacking.** Stevens, D.F. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 12p. (CONF-871209—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87009643/JAW.

From International conference on the management and performance evaluation of computer systems; Orlando, FL, USA (8 Dec 1987).

On August 23, 1986, it was noticed that the accounting files for one of LBL's computing systems failed to balance. On August 24, we received word that an unauthorized person was attempting entry into a US Navy computer from LBL. Preliminary investigation indicated that LBL was the victim of a benign hacker, where "benign" is used in the medical sense. It was thought that the perpetrator was a graduate student from a neighboring university, and that it would provide a useful object lesson to other such folk if he were caught and admonished. LBL therefore embarked upon a journey of detection and containment instead of prevention. That journey continues today, having led first across the country, then across the Atlantic. In the course of the journey we have gathered a number of observations that should be of interest to anyone running a computer with any connection to the outside world.

5344 **(ORNL/TM—10463) Optimizing the Zilog Z8 FORTH microcontroller for rapid prototyping.** Edwards, R. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001408/JAW.

This report presents techniques for modifying and extending Zilog Z8 FORTH microcontroller system software to improve its suitability for rapid prototyping, an increasingly popular method of developing new products and services. Rapid prototyping requires special product development methods and tools because it often mandates short term, radical changes in the concept being developed. Use of a high-performance, easily adaptable microcontroller can greatly facilitate a laboratory evaluation of Smart House product prototypes. Such a device can meet numerous sensing and testing needs, including the important function of simulating the operation of Smart House components associated with the one being tested. The techniques described in this report improve Z8 execution rates up to 300% by replacing selected parts of the vendor-supplied FORTH software with routines optimized for speed rather than program size. Also, the report shows how to exploit an unusual Z8 FORTH system feature to simulate a multitasking environment (concurrent execution of several tasks). This information is provided to project participants to help them select development and test equipment for Smart House products. The material is technical in nature and assumes considerable experience in microcontroller technology and microcomputer programming. 6 refs.

5345 **(OU/ME—830701) Mathematical modelling of heat transfer in permanent molds.** Salcudean, M.; Mashaie, A. (Ottawa Univ., Ontario (Canada). Dept. of Mechanical Engineering). 1 Jul 1983. 124p. (MICROLOG—85-4031). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A mathematical model simulating the solidification of castings from pouring through freezing was constructed. The process is governed by a set of Partial Differential Equations. The Finite difference approximation was used to create a system of linear algebraic equations from the set of Partial Differential Equations. This was done using the energy balance method. An Alternating Direction Implicit method was used to solve the governing differential equations. The tridiagonal system of algebraic equations was solved using the tridiagonal matrix algorithm. A flow chart has been developed and a FORTRAN program was written for the numerical scheme. Preliminary testings of the model was done for a Simple Two-Dimensional solidification problem in cylindrical polar coordinates. The temperature distributions and profiles in the casting and mold, solidification front profiles and solidification time were computed. The model was compared with data from the literature. 35 figs., 1 tab.

5346 **(PB—87-219762/XAB) Connectionist models and geometric reasoning.** Fallside, F.; Chan, L.W. (Cambridge Univ. (UK). Dept. of Engineering). 1986. 27p. (CUED-F-CAMS-TR—266). NTIS, PC E05/MF E05.

There is growing interest in the use of connectionist models for pattern processing. This arises from their biological plausibility - that they may be analogous to processing by the brain, from an increasing number of demonstrations of their pattern processing capabilities and since they employ inherently parallel processing and can thus exploit developments in parallel-processing hardware. To date they have been applied to a number of exploratory problems in AI, for example in vision, speech and language. They are at an early stage of development - for example, they consist of a variety of models and training algorithms with exploratory results - rather than being in any way canonic.

5347 **(PB—87-220323/XAB) Space-filling-curve method: an implementation and applications. Research note.** Uusitalo, M.; Haemaelaeinen, O. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1987. 78p. (VTT/RN—698). NTIS, PC E04/MF E01.

The formulation of space-filling curves for one-to-one bidirectional mappings between multidimensional and one-dimensional spaces is presented. The method, based on the original mathematical formulations from the late 19th century, can be implemented by using modern computer technology. Computer implementations of the method have several potential application areas such as digital image processing in the two-dimensional case and associative data bases in the general multidimensional case. The report consists of three major topics. First, the properties and different realizations of space-filling curves are described. Second, a computer implementation of the corresponding algorithms is presented. Third, some potential application areas of the method are shown. Detailed descriptions of the installed algorithms are given in the appendix.

5348 **(SAND—85-2344) Sandia software guidelines: Software quality planning.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001931/JAW.

This volume is one in a series of Sandia Software Guidelines intended for use in producing quality software within Sandia Na-

tional Laboratories. In consonance with the IEEE Standard for Software Quality Assurance Plans, this volume identifies procedures to follow in producing a Software Quality Assurance Plan for an organization or a project, and provides an example project SQA plan. 2 figs., 4 tabs.

5349 **(SAND—86-2173C) Structuring data for concurrent vectorized processing in a transient dynamics finite element program.** Flanagan, D.P.; Taylor, L.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871207—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013082/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Most transient dynamics analysis programs employ explicit time integration with a lumped (diagonalized) mass matrix. These programs predict the response of solids to intense dynamic loads, such as crash, penetration, or explosive loads. The explicit integration architecture avoids the solution of coupled matrix equations, which is of great advantage in these highly nonlinear problems. Explicit integration algorithms are naturally well suited to both vector and concurrent processing. However, to realize the advantage of concurrent vector processors, many traditional schemes for managing finite element data in memory must be changed. Optimal performance requires vectorization of as much code as possible. Finite element programs must be designed from a data flow perspective in order to fit comfortably into the architectures of modern computing hardware. A synopsis of how this approach was taken for production transient dynamic analysis programs PRONTO 2D and PRONTO 3D is presented. There are two points in the explicit integration loop where each finite element cannot be processed independently. The first is the gathering of nodal data (coordinates, displacements, velocities, etc.) via the element connectivity table. The second is the assembly of nodal force contributions from each element. These two processes dominate overall performance. The implications of the hardware architecture of concurrent processors on these crucial areas will be discussed. 2 refs.

5350 **(SAND—86-2294C) Indirect solution of static problems using concurrent vector processing computers.** Biffle, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-871207—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012105/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Indirect equation solvers such as the conjugate gradient method have been successfully vectorized and are capable of efficiently solving very large three-dimensional nonlinear static problems. A further reduction in job turn around time may be accomplished with concurrent vector processing computers. The nonlinear conjugate gradient algorithm is adapted to concurrent vector processing computers while striving to preserve the vector processing speed of the algorithm. It is critical that the nonlinear capabilities of the code are still efficiently processed under the concurrent algorithm. The algorithmic performance for two highly nonlinear three-dimensional problems is discussed. 7 refs., 4 figs.

5351 **(SAND—87-2009C) An Ada graphical tool to support software development.** Maxted, A.; Rowe, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 9p. (CONF-871225—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014854/JAW.

From ACM SIGAda international conference on the Ada programming; Boston, MA, USA (9 Dec 1987).

Significant work has been done by others on tools that allow software engineers to graphically illustrate software designs and, in some cases, to produce code automatically from the graphical design. What we posit here is that, given the current technology available in the marketplace, over the life of a typical software project it is more beneficial to produce accrue graphical representations of a software design from the code. We have developed a prototype tool that will take as input any legal Ada compilation unit, or set of units, and produce a precise graphical representation of those unites. Because of the inherent suitability of Ada as a compilable Program Design Language (PDL), our tool is usable virtually throughout the software development life-cycle. This tool has been used successfully at Sandia National Laboratories during the preliminary and detailed design phases of a medium-sized software development project; moreover, we believe benefits will continue to accurate during the later stages of the life-cycle, particularly software maintenance and enhancement. 9 refs., 5 figs., 1 tab.

5352 **(TWE—85) Computer aided data acquisition and analysis system for a conduction calorimeter.** (3rd Wave Engineering, Kanata, Ontario (Canada)). 1985. 30p. (MICROLOG—85-3420). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Conduction calorimeters are used to study the hydration of hydraulic cements under nearly isothermal conditions. The hydrating cement produces temperature changes, in the order of 1 degree C, and the temperature sensor outputs are typically displayed on strip chart recorder over periods extending up to seven days. Determining the total heat evolved requires an integration of the temperature history and determining the instantaneous rate of heat evolution requires differentiation of the temperature history. The rate of change of heat evolution can provide further information on the kinetics of the reactions occuring during hydration. Determining this rate of change requires then a second differentiation of the conduction calorimeter output. The large volume of data produced and the difficulty of obtaining accurate differentials, especially when second derivatives are involved, make cement hydration calorimetry an ideal candidate for Computer Aided Data Acquisition and Analysis. 2 figs.

5353 **(UCID—21191) Image and Signal Processing LISP Environment (ISLE).** Azevedo, S.G.; Fitch, J.P.; Johnson, R.R.; Lager, D.L.; Searfus, R.M. (Lawrence Livermore National Lab., CA (USA)). 2 Oct 1987. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001928/JAW.

We have developed a multidimensional signal processing software system called the Image and Signal LISP Environment (ISLE). It is a hybrid software system, in that it consists of a LISP interpreter (used as the command processor) combined with FORTRAN, C, or LISP functions (used as the processing and display routines). Learning the syntax for ISLE is relatively simple and has the additional benefit of introducing a subset of commands from the general-purpose programming language, Common LISP. Because Common LISP is a well-documented and complete language, users do not need to depend exclusively on system developers for a description of the features of the command language, nor do the developers need to generate a command parser that exhaustively satisfies all the user requirements. Perhaps the major reason for selecting the LISP environment is that user-written code can be added to the environment through a "foreign function" interface without recompiling the entire system. The ability to perform fast prototyping of new algorithms is an important feature of this environment. As currently implemented, ISLE requires a Sun color or monochrome workstation and a license to run Franz Extended Common LISP. 16 refs., 4 figs.

5354 **(UCRL—96426) Conceptual issues in measuring the behavior of a distributed real-time process-control computer system.** Lawrence, J.D. (Lawrence Livermore National Lab., CA (USA)). 8 May 1987. Contract W-7405-ENG-48. 23p. (CONF-871209—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87009748/JAW.

From International conference on the management and performance evaluation of computer systems; Orlando, FL, USA (8 Dec 1987).

Measuring the performance, reliability and availability of a distributed real-time process-control fault-tolerant computer system presents a variety of interesting problems. A method is described by which this task can be organized efficiently, and by which appropriate measures can be delivered to a variety of different user groups. This involves constructing a system structure tree that organizes all of the hardware and software of the computer system. Subtrees are identified that provide information to the various

users. Some of the problems that one can expect to encounter are discussed. 25 refs.

5355 **(UCRL—96426-Rev.1) Conceptual issues in measuring the behavior of a distributed real-time process-control computer system.** Lawrence, J.D. (Lawrence Livermore National Lab., CA (USA)). 14 Aug 1987. Contract W-7405-ENG-48. 18p. (CONF-871209—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014251/JAW.

From International conference on the management and performance evaluation of computer systems; Orlando, FL, USA (8 Dec 1987).

Measuring the performance, reliability and availability of a distributed real-time process-control fault-tolerant computer system presents a variety of interesting problems. A method is described by which this task can be organized efficiently, and by which appropriate measurements can be provided for a variety of different user groups. This involves constructing a system structure graph that organizes all of the hardware and software of the computer system. Subgraphs are identified that provide information to the various users. A particularly important type of user is the equipment, or process, being controlled. Some of the problems that one can expect to encounter are discussed. 23 refs., 2 figs.

5356 **(UCRL—96730-Rev.1) ISLE [Image and Signal LISP Environment]: A functional language interface for signal and image processing.** Azevedo, S.G.; Fitch, J.P. (Lawrence Livermore National Lab., CA (USA)). 21 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871162—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001889/JAW.

From 21. annual asilomar conference on signal, systems, and computers; Pacific Grove, CA, USA (2 Nov 1987).

Conventional software interfaces that use imperative computer commands or menu interactions are often restrictive environments when used for researching new algorithms or analyzing processed experimental data. We found this to be true with current signal-processing software (SIG). As an alternative, "functional language" interfaces provide features such as command nesting for a more natural interaction with the data. The Image and Signal LISP Environment (ISLE) is an example of an interpreted functional language interface based on common LISP. Advantages of ISLE include multidimensional and multiple data-type independence through dispatching functions, dynamic loading of new functions, and connections to artificial intelligence (AI) software. 10 refs.

5357 **(UCRL—97281) The simulation of command and control in the Conflict Model (ConMod).** Chiu, Yu-Hsing; Jones, C.D.; Kreis, G.D.; Simonson, S.C.; Strange, S.M.; Tannahill, J.R. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 30p. (CONF-8706218—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000969/JAW.

From Joint directors of laboratories command and control research symposium; Washington, DC, USA (16 Jun 1987).

The Conflict Model (ConMod) is an analytic computer model for simulating military conflict at the corps and echelons above corps levels. The model addresses operational concepts of air and ground forces engaged in deep, rear, and close combat. The model simulates selected aspects of combat, combat support, and combat service support in an air/land battle. Command and control is an explicit and integral part of the simulation. ConMod is based on a control system approach to organizations. Key concepts of the model include separation of cognitive and physical activities, cause and effect audit trail, discrete event simulation, and extensible architecture. The command and control (C^2) system in ConMod takes an object oriented approach. Generic military objects with scenario dependent links form military organization hierarchies and C^2 networks. Planning may be automatic below a selectable organizational level. Automatic planning involves processes of planning, directing, controlling, reporting and coordinating. ConMod uses high resolution physics for simulation. The model has a comprehensive system support environment. ConMod is designed as an analytic tool, but with its flexible model architecture, ConMod is adaptable to research, operational support, and training purposes.

5358 **(Y/DU—477-Suppl.) Smoothing rate data by repetitive integration and differentiation using Pade approximants of linear NOLOR functions.** Johnson, R.W.; Tinnel, P.I. (Oak Ridge Y-12 Plant, TN (USA)). May 1986. Contract AC05-84OS21400. 34p. (CONF-860588—2-Suppl.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001822/JAW.

From American Association for the Advancement of Science annual meeting; Philadelphia, PA, USA (25 May 1986).

Repetitive integration and differentiation of slab diffusion rate data allows the estimation of diffusion parameters from smoothed values of the rate (R), the normal of the logarithm of the rate (NOLOR, B), and the NOLOR prime (B') at each data point. However, the estimates for the first few and the last few points may be biased.

5359 **Design of electromagnetic devices using commercial finite element programs.** Johnson, M.; Wands, R.; Wolin, E. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Review of Scientific Instruments;* **58**: No. 12, 2317-2323(Dec 1987).

The two-dimensional electrostatic modeling capability of the ANSYS finite element program is used in the design of the coax-to-parallel plate microwave transformer. Its two-dimensional axisymmetric capability is used in the design of a laser-triggered coaxial Blumlein spark gap. Finally, its three-dimensional magnetic modeling ability is used to model a large dipole magnet (the Chicago cyclotron magnet). The results of the calculations compare well with measurements for two of the above cases.

5360 **Simulations of structure, dynamics and transformations in finite aggregates.** Landman, U.; Barnett, R.N.; Cleveland, C.L.; Luo, J.; Scharf, D.; Jortner, J. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *AIP (American Institute of Physics) Conference Proceedings;* **162**: No. 1, 200-244(30 Oct 1987). (CONF-8704193—).

From Few-body systems and multiparticle dynamics conference; Crystal City, VA, USA (20 Apr 1987).

Classical and quantum molecular dynamics simulation methods for investigations of the energetics, structure and dynamics of small clusters are opening new avenues for detailed microscopic studies of these systems. We review the simulation techniques and demonstrate their versatility, and richness of information which they afford, via studies of isomerization and melting transformations in small clusters, modes of electron localization in clusters and the dynamics of fragmentation and energy pathways following an electronic excitation of rare-gas clusters.

9903 Information Handling

REFER ALSO TO CITATION(S) 3240, 3482, 3484, 4434, 5076

5361 **(CONF-8611101—) Department of Energy/Contractors Micrographics and Information Management Association 14th annual conference.** (Department of Energy/Contractors Micrographics and Information Management Association (USA)). 1986. Contract W-7405-ENG-48. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000230/JAW.

From 14. annual conference of the Department of Energy/Contractors Micrographics and Information Management Association; Pleasanton, CA, USA (4 Nov 1986).

Individual papers are processed separately for the data base. (DLC)

5362 **(DOE/TIC—7000-R7-App.) Subject thesaurus permuted listing: Energy Data Base.** Raridon, M.H. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Sep 1987. 257p. OSTI, P.O. Box 62, Oak Ridge TN 37831. Order Number TI87009896/JAW.

This permuted listing, an appendix to the Energy Data Base: Subject Thesaurus (DOE/TIC-7000-R6), has been prepared to alleviate the problems of entry to a large multidisciplinary thesaurus

containing both single and multi-word descriptors. It is designed to be used in conjunction with the Subject Thesaurus and is not to be used alone. Each descriptor, whether a single word or multi-word entry, has been permuted and alphabetized by each significant word. The complete descriptor is given at each point.

5363 **(UCID—21198) LOGDIS [Logistics Data Integration System]: Productivity evaluation report.** Schultz, E.E.; Abrahams, S.; Banks, W.W. Jr. (Lawrence Livermore National Lab., CA (USA)). 26 Aug 1987. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002282/JAW.

This report presents the results of an end-user productivity study associated with the implementation of LOGDIS (Logistics Data Integration System), a prototype LLNL Gateway system. Its purpose is to provide AFLC decision-makers with data pertaining to estimates of any productivity changes that can be expected or realized by the use of advanced technology and applications software. The effort described in this report focuses on objective functional user productivity and performance changes which can be attributed directly and objectively to LOGDIS.

9904 Law

5364 **(INIS-XN—72) Decree of 2 July 1986 concerning the technical/scientific pluridisciplinary commission to study problems in certain fields requiring public protection measures.** (International Atomic Energy Agency, Vienna (Austria)). 29 Jul 1986. 2p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700052/JAW.

Published in Gazzetta Ufficiale della Repubblica Italiana.

This Decree of 2nd July 1986 (published in the Official Gazette of 29th July 1986) sets up a pluridisciplinary Commission which will advise the Minister for Protection of the Public in case of emergency situations in certain fields requiring public protection measures. The risks covered are the following: seismic, nuclear, volcanic, hydrological, chemical/industrial and ecological and finally, risks which may arise during transport. (NEA).

5365 **(INIS-XN—75) Order of 13 December 1985 on the transfer to ENRESA of the Radioactive Waste Management Facility at Sierra Albarrana.** (International Atomic Energy Agency, Vienna (Austria)). 4 Jul 1984. 2p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700053/JAW.

This Order provides for the transfer of the Radioactive Waste Management Facility at Sierra Albarrana from the Junta de Energia Nuclear to ENRESA, the National Enterprise for Radioactive Waste; it also organises all stages of the transfer. (NEA).